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January 25, 1923

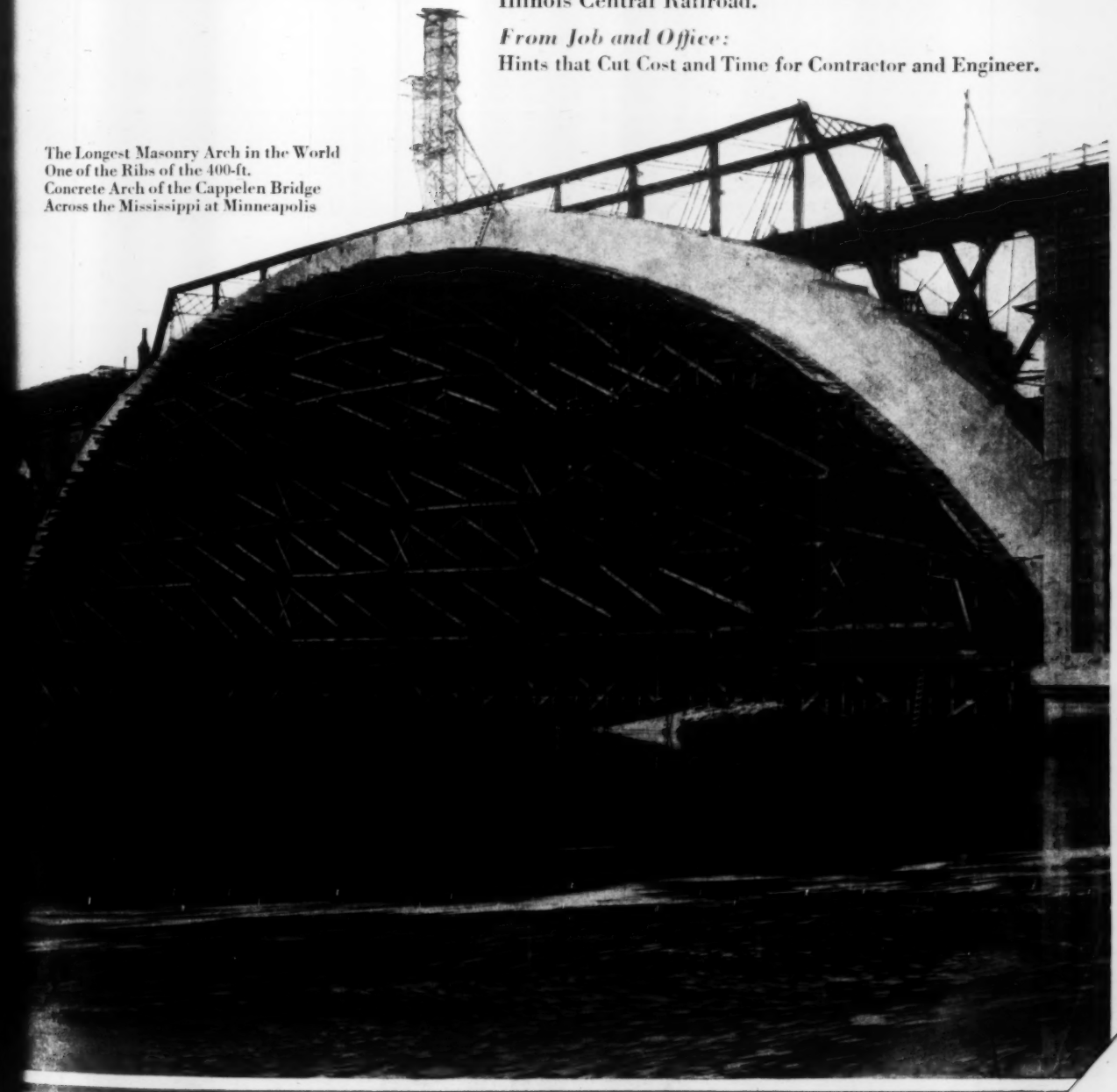
Engineering News-Record

Report of the Annual Convention of the American Roadbuilders' Association.

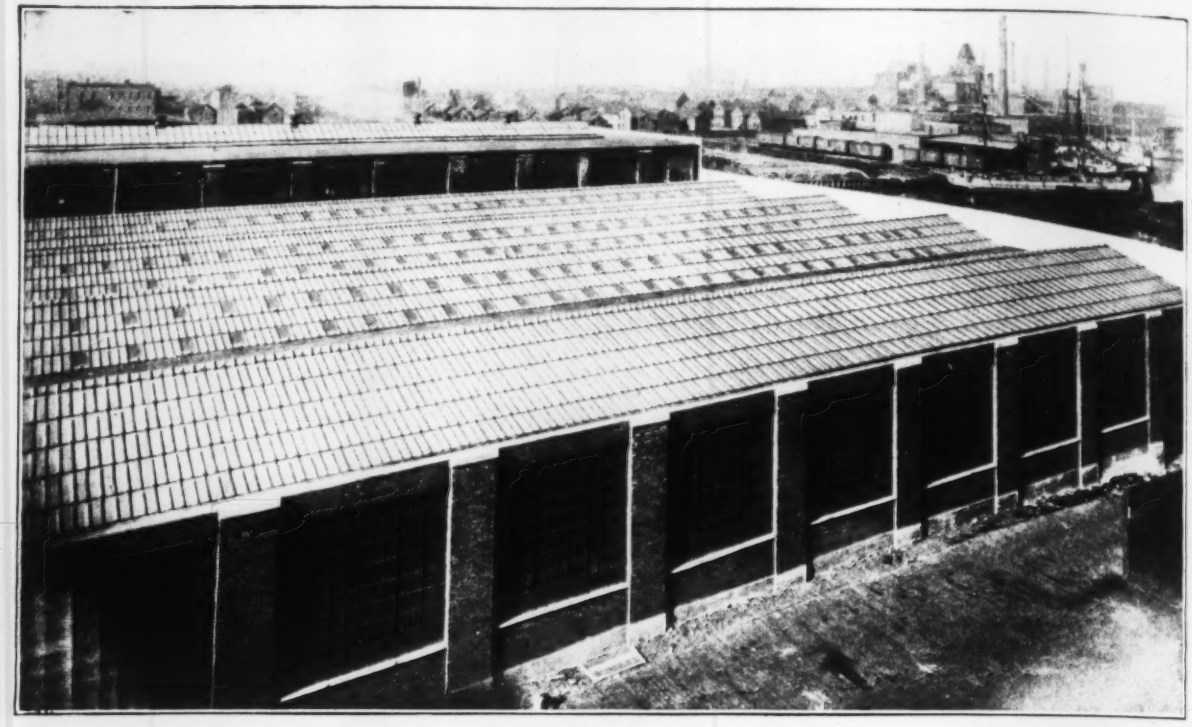
Design of the Cappelen Bridge at Minneapolis the World's Longest Masonry Arch.

Rail Reclamation Practice on the Illinois Central Railroad.

From Job and Office:
Hints that Cut Cost and Time for Contractor and Engineer.



The Longest Masonry Arch in the World
One of the Ribs of the 400-ft.
Concrete Arch of the Cappelen Bridge
Across the Mississippi at Minneapolis



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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. Mehren, Editor

Volume 90 — NEW YORK, JANUARY 25, 1923 — Number 4

The Civil Engineers Speak

IN DEMANDING an early trial for those of its members who have been caught in the sweep of the indictments and civil actions arising out of the alleged camp-construction frauds, the American Society of Civil Engineers has risen to a responsibility incumbent upon it as national spokesman for the civil engineers of the land. As has been pointed out in these columns, these indictments transcend the personal and impeach the competence and the honor of the construction industry, in which the civil engineer is so important an element. Until these charges have been proved or refuted the engineering profession has a duty to perform—a duty to itself, to the American public and to those of its ranks who contributed so worthily to the needs of their country and who now stand accused, along with the defendants. Speedy punishment for the guilty and equally speedy exoneration for the innocent are but the minimum requirements of plain justice, and the society does well thus to register the sentiment of the profession.

Engineers and the Traffic Problem

FROM cities both large and small evidence indicating the seriousness of the traffic problem keeps accumulating and from the automotive industry and the motor-vehicle registration bureaus of the states figures are received showing an ever-increasing production and a correspondingly high registration. Existing conditions have forced upon the public an appreciation of the need of improved methods of traffic control if streets are to be made passable for the movement of vehicles and the crossing of pedestrians. Traffic control began as a police function and has developed very largely under police administration. Engineers, until recently, have had an insignificant part in its development and yet it is essentially a problem on which engineering thought is needed, particularly at the present time when all sorts of schemes involving the cutting of new streets through built-up sections of cities, elevated vehicle roadways, street widening projects, arcaded sidewalks, pedestrian tunnels or bridges across crowded thoroughfares are being suggested as solutions. Many of these projects, of course, are impracticable while others may become realities in the near future. Certain it is that the engineer should have a deciding voice in the adoption or rejection of plans for the solution of the city traffic problem.

Some Special Pleading

IN COMMON with many others, we have noted with concern the growing number of automobile killings in the United States and have demanded a greater care on the part of both drivers and pedestrians and a more serious consideration of the traffic problem by the governmental authorities. To us this has seemed a most serious menace and one which is increasing. We find now, however, on reading a recent article in an automobile journal that the danger is exaggerated; that while in fact the total number of deaths due to automobiles is increasing the number *per automobile* is decreasing. In other words, by analogy if the number of yellow-fever deaths increase there need be no concern so long as the deaths per fever-bearing mosquito decrease. Or possibly this statistician would claim that, like the dog who by ancient common law is entitled to one bite, every automobile is entitled to one accident.

A Notable Arch

FOR a record-breaking structure the big arch of the Cappelen bridge at Minneapolis is of amazing simplicity. When one recalls that not fifteen years ago any masonry arch of over 200 ft. span was worthy of special record for its size alone, the design and construction of one of 400 ft. span would seem to call for almost prayerful study. The Minneapolis engineers, however, do not appear to have found the bridge of more complication than a similar one of much smaller size, and while they have insured its safety and economy by all proper precautions they have done little more either in design and construction than to apply the accepted principles of concrete arches. All three arches, the two of 200 ft. and the main span of 400 ft., are in reality plain concrete ribs in which large steel frames are incorporated for the general purpose of toughening the concrete rather than for specific tensile service. Few of the complexities of reinforced concrete had therefore to be considered in the main members, and the design resolved itself merely into a question of large-scale masonry arch design. Construction was equally simple, especially in the enlargement to mammoth size of the common multiple-post timber falsework for which the shallow stream and the firm subsoil presented highly favorable conditions. Taken all in all the Cappelen bridge is notable not only because it is the largest masonry arch in the world built at a location not naturally suited to arch construction, but also because it demonstrates how the art of design can progress evenly through successive stages to application to unexpected dimensions.

Sanitary Engineering Broadened

SANITARY engineering has been restricted by some in times past to include nothing or little except sewerage. This has been more notable in England than America, and a few decades ago than now: as witness Baldwin Latham's "Sanitary Engineering," which was devoted to sewerage, and the later British work of the same title by Moore and Silcock, which went a little further afield and included refuse disposal. In America, sanitary engineering has been recognized as having a wider scope, but aside from the textbook Merriman's "Elements of Sanitary Engineering," American engineering literature has no book on sanitary engineering as a whole. All this may be due in large part to the

vastness of the subject, which has led to works on one branch alone and found them requiring large volumes like Flinn, Weston and Bogert's "Water-Works Handbook," or Hering and Greeley's "Municipal Refuse," or extending into two, like Ogden's "Sewer Design" and "Sewer Construction," or into three, like Metcalf and Eddy's "American Sewerage Practice."

Nothing short of a liberal shelf length would suffice for a series of comprehensive treatises that would be required to cover all the phases of the five-fold division of sanitary engineering given in H. P. Eddy's address following the organization of the Sanitary Engineering Division of the American Society of Civil Engineers last week. Condensed to one word each, Mr. Eddy's five divisions are water, sewerage, scavenging, insects, and air.

The function of the Division of Sanitary Engineering, Mr. Eddy suggested, is to advance the science and art of each of these five divisions, and the chief ways and means of doing this are co-operative research and the dissemination of sound information. Not the least of the latter is the bringing home to city officials, voters and taxpayers the fact that to maintain the integrity of sanitary engineering works by adequate maintenance, and to ensure efficient operation, is as much the function of the sanitary engineer as is design and construction. This, with the five-fold division of the subject, is a broader conception of sanitary engineering than is held, we fear, by some members of the profession and much broader than has yet been grasped by one in a thousand of city fathers and the people they are chosen to serve.

Prepare Now for Next Year's Road Show

HIGHWAY improvement occupies a better position among the engineering activities of the country as the result of the convention and exhibition put through in Chicago last week by the roadbuilding interests of America. This new rank is not merely because an intelligent list of highway questions was discussed by men high in the roadbuilding councils of state and nation but because an association, in one organization, of all persons concerned in highway development has shown that it can activate vitally and with entire harmony of various personal interests. The engineer, the contractor, the materials producer and the equipment manufacturer each demonstrated at last week's convention that he can to his own advantage work in association with all the others to perform a great educational task.

No other organization in the field of highways serves the same broad purpose as does the American Road Builders' Association. It embraces every person and every interest having scientific concern with and practical duties to perform in road construction. The Association of State Highway Officials is, in contrast, a close organization of public officials. Other associations have special fields, like that of highway transport, and many are merely bureaus for roadbuilding propaganda, or special privilege, of one sort or another. To note the success, therefore, of the only association of all technicians engaged in roadbuilding is gratifying, particularly following a period of disorganization which at times threatened to be fatal.

The reasons for the quick recovery of the last year need not be considered. It is more important to prepare to satisfy the obligations of next year. In the convention and exhibition which are to come in another twelve months a greater task is promised than that which confronted those who conducted the work of the convention and exhibition which have just closed. Such perfection as characterized the activities at Chicago last week was due to preparations begun far in advance of those of any previous years. This lesson should not be lost. Preparation for the congress and road show of 1924 should be begun immediately.

An Analogy and a Suggestion

IN COMMENDING the report on the New York transit problem published by the Merchants' Association of that city, *The New York Times* speaks as follows:

> The report . . . is of first-class value. It is the work of a committee of experts. They have been studying the questions involved for a long time, without fear or favor. Personalities they put entirely out of their findings. The political bearing of the subject they pass by as beneath notice. They are not concerned with winning votes, but with doing something for the great body of passengers who are overcrowding our transit facilities, and whose larger interests have been almost lost sight of in the squabbling of politicians.

All this, with appropriate changes in wording, might be said with equal force concerning the work of the Board of Economics and Engineering of the National Association of Owners of Railroad Securities, in its investigation of the equally harassing but vastly more far-reaching problem of the New York Port terminals of the trunk-line railroads. That board, too, was "a committee of experts," all engineers, eminently qualified for their undertaking. It is a coincidence, indeed, that Col. F. A. Molitor happens to have been chairman of the merchants' committee as well as of the security owners' board. The analogy follows even more closely. Just about the time the board took up the terminal problem alternative plans for its solution were much in the public eye, and we doubt not the board found itself compelled to do just about what the *Times* says the merchants' committee has done, that is "to take the two plans . . . before the public and subject them to minute scrutiny and searching analysis." Probably it did just that and then drew generously upon its native wit and aggregate experience to supplement whatever it may have found worth while in the rival proposals.

Unfortunately, however, all this must remain the subject of speculation alone, for the report that embodies the findings and the judgments of the board has not yet been made public. Requests for its publication, conformably to the precedent set up in an earlier study of the Chicago terminals, have been of no avail. For some reason the report on the New York terminals has been suppressed. Just why, no one seems to know and it would be futile and unfair to hazard a guess.

But now that the Interstate Commerce Commission has been invoked to iron out the differences between the Port Authority and the railroad managements, is it too much to hope that someone may be prevailed upon to let us know what is in this jealously guarded report? It is quite possible that the revelation might leave us unsatisfied and disappointed. Maybe the security owners think there is not a helpful idea in the entire document. Perhaps that is why it has been withheld.

But what harm though it should be a "dud"? What harm could befall the railroads, or the City of New York, or the Port Authority or the general public if these engineers had failed to hit upon the right answer? They have not the authority to impose their ideas on the community, and if their ideas are unsound those who have the authority may easily reject them. At least we should have the benefit of the findings and the opinions of an exceedingly able committee.

We commend to the Interstate Commerce Commission, therefore, simply as a worth-while speculation, a reading of the report on the New York terminals prepared for the National Association of Owners of Railroad Securities by its Board of Economics and Engineering. That is, of course, provided it can manage to get hold of a copy.

From Politics to Production

IT WAS evident last week that a new spirit animates the American Society of Civil Engineers. That it is felt by most of the membership was proved by the spontaneously voiced opinions of many men representing different orientations and geographical locations. The large attendance at the annual meeting, the general atmosphere of activity and interest, the technical character of the proceedings, and several developments in the direction of more efficient work, were expressions of this spirit. In its essence it is one of determination to work hard in co-operation for the advancement of engineering, and quite obviously it rests on a restored belief in the overshadowing importance of technical activity. There is every evidence that the new spirit will endure. It means progress.

With this happy change it becomes certain that the political turmoil which marked the society's recent past has subsided—soon to end finally, no doubt—and that useful production is resumed. The sword has been beaten into the ploughshare. The turn of events is to the advantage of all, not merely the members of the society but all votaries of the civil engineering profession. Now that the dominant professional organization again devotes its great energies solely to the advancement of engineering science and art, the profession regains the strength which resides in union.

The meeting was of a character well suited to the celebration of the society's seventieth anniversary. It embodied an interesting divergence from a precedent set by former ages, according to which the membership gathered together from distant parts of the country once a year for the sole purpose of discussing administrative business; for almost the first time the annual meeting was made a technical gathering. But while this innovation was significant, more important expressions of the realignment of purpose in the society were the organization of technical divisions and the definite recognition of research as a major phase of the society's work.

The organization of technical divisions was in a sense the outstanding event of the meeting. Sanitary, power, irrigation and highway divisions were formed, and, with others likely to follow soon, the society may be said to have changed overnight from the form of a large unwieldy committee of the whole to an assemblage of specialized working groups co-ordinated by general meetings and joint counsel and co-operation. Whether or not the change will prove to be thoroughgoing, a sound course of development is assured; the organizing sessions brought together strong gatherings of specialists imbued with the will to do useful work—and no brighter promise of success could be asked. Many organizational details are yet to be worked out, but since able men are back of the movement, in the divisions as well as in the general councils of the society, a sound solution of the remaining problems may be counted on. Further, as the experience of other societies in specialization is available as guide and warning, there need be no apprehension that the mistake will be made of providing the deadening excess of mechanism with which some such movements have burdened their parent bodies.

But while the technical specialization, being new, attracted most attention, it is inherently no more significant of the recrystallization of spirit and purpose within the society than the affirmation of the policy of stimulating research. Established in a tentative way a year ago, the policy received its final endorsement at the present meeting. The attitude of the membership was made evident in a separate session devoted to research. The view of the governing authorities of the society expressed itself in the creation of two further special research committees, adding to the half dozen or more which have been at work during the past year. Thus the society progresses in carrying out by new means its foundation aim of advancing engineering knowledge, and it does this by calling into action increasingly larger numbers of its members under specific assignment of work.

In respect to both specialization and research the society has now assumed consciously and effectively a function which heretofore it performed only vaguely and indirectly, namely that of stimulating and drawing out the productive capacity of its membership to the benefit of professional knowledge. The technical division system serves this end by concentrating the ability of the various specialists among the membership in separate groups where the power of mutual influence will be greatest. The cultivation of research serves the same end by providing means of assembling the questions and undetermined points of engineering science and bringing to bear upon them the many scattered investigative powers existing within the organization. The certain result will be an increased efficiency of society work, through the systematization and concentration of vital agencies which have been unco-ordinated until now. Thus the society's intellectual and technical resources are integrated and made of greater service to the profession and to the world.

These developments within the society are unmistakably bound up with the new spirit observable at last week's meeting. But it is neither necessary nor profitable to speculate whether they are the result of the new spirit or its source. The important thing to note is that all that is being done works to strengthen the bond between member and society, the bond of purposeful technical work.

Only a modest beginning has been made so far in the new activities, let it be remembered. Even in these beginnings, however, it is evident that they are connected with the life nerve of the society's existence. They have meaning and importance then for the whole profession, and give a solid basis for the most hopeful expectations concerning the fuller development of our civil engineering art.

Design of 400-Ft. Concrete Arch of the Cappelen Memorial Bridge

Largest Concrete Arch Ever Built Will Be Completed This Year—Span Required to Provide Navigation Waterway and Clear Old Bridge—Thrust Partly Balanced by 199-Ft. Side Spans

WITH the largest concrete span in the world, a 400-ft. arch containing 2,300 cu.yd. of concrete in each of its two ribs, the Mississippi River bridge at Franklin Ave., Minneapolis, recently renamed the Cappelen Memorial Bridge in honor of the engineer who planned

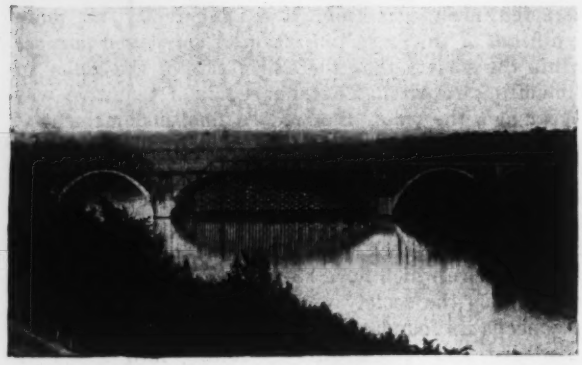


FIG. 1—CAPPELEN BRIDGE OVER MISSISSIPPI RIVER
Centering of 400-ft. arch under downstream rib

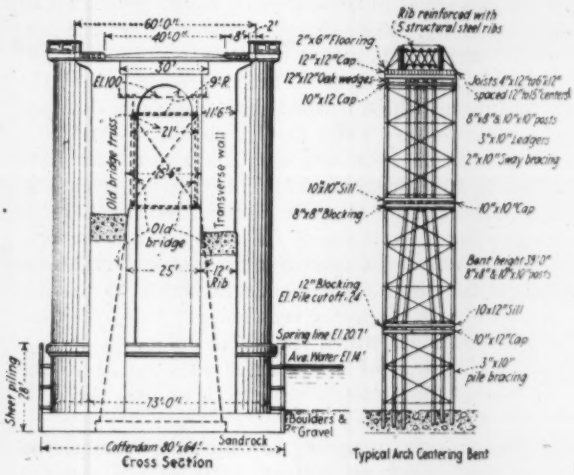
it and began its construction, is one of the most important and interesting works of structural engineering now in progress. Aside from its magnitude, it is remarkable for being built by the city as force-account work; all Minneapolis construction has been done in this way for years.

Though it constitutes a formidable engineering problem, the bridge is strikingly simple both in its design and in the construction methods being applied to it. Under N. W. Elsberg, superintendent of construction for two years and now city engineer, the work has progressed to completion of the piers and ribs, and concreting of the floor is now in progress. The coming season will see the completion of the structure.

Preliminary data, with an outline sketch, were given in these pages Feb. 12, 1920, p. 335. The leading considerations and data of the design, made available by Mr. Elsberg and K. Oustad, bridge engineer for the city, are given in the present article.

Governing Conditions at the Site—Located in the southwestern residential district of Minneapolis, Franklin Ave. crosses the Mississippi as one of the main connecting links between two well settled sections. The old structure here is a five-span steel bridge about thirty years old, with a roadway only 18 ft. wide; its 302-ft. main span is of through arrangement, while the four 174-ft. side spans are deck. It has long been inadequate and its replacement has been contemplated for a number of years. After completion of the South Third Ave. bridge—ten 200-ft. concrete arch spans—seven years ago, F. W. Cappelen, the city engineer, at once put the Franklin Ave. crossing problem under study. The new concrete arch bridge is the outcome of this study.

Permanence and monumental appearance were desired in the new bridge, the latter quality because of park and residential surroundings and the scenic value of the site. This pointed to a masonry or concrete arch structure. With regard to navigation requirements, however, a span of at least 300 ft. would be necessary. Nevertheless, Mr. Cappelen developed a project for a concrete arch crossing to replace the old bridge, and it was subsequently approved by the city government and



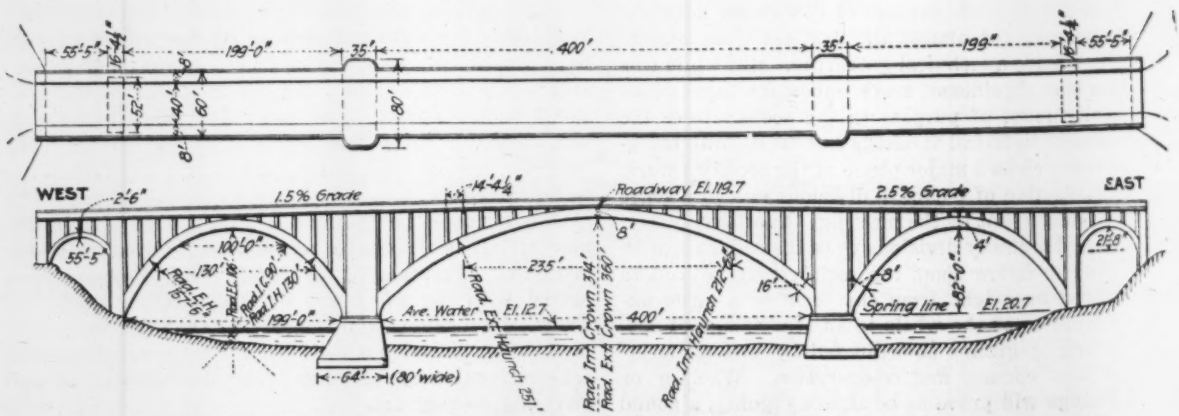


FIG. 2—FRANKLIN AVE. CONCRETE ARCH BRIDGE—THREE-STORY CENTERING FOR MAIN ARCH RIB

the necessary funds voted by the city council. Construction began in the latter part of 1919.

General Conditions—Franklin Ave. crosses the river near the head of the Mississippi River gorge lying between Minneapolis and St. Paul. The river is about 900 ft. wide here, or about 1,100 ft. between the edges of the bluffs. The banks are about 100 ft. high, of limestone, while the river bed is in St. Peter sandstone, thinly covered with drift and alluvium. Sound rock lies 15 to 30 ft. below water. Thus, a good foundation is available for any type of structure. River navigation is not at present important, but is expected to become so in future with the aid of ponding by the government dam several miles downstream, completed a few years ago. A wide channel with substantial clearance height was therefore demanded by the War Department (minimum width 300 ft., clearance height 50 ft.).

as now being carried out, and as shown in the drawing and views herewith.

The detailed design, largely worked out by Mr. Oustad, is unusually simple in its architectural features, making use of almost no ornament; for example, the ends of the spandrel columns are simple square faces, without any molding. The result is a demonstration of what can be achieved with plain details provided the structural proportioning is good.

For simplicity in construction, a slab-and-floorbeam deck (without stringers) was adopted. Since street-car loadings were to be provided for, a reasonable limitation of slab thickness restricted the column spacing to about 15 ft. longitudinally of the bridge. The adopted spacing in the main span (14 ft. 4½ in.) was maintained also in the side spans, with suitable detail adjustment of span length.

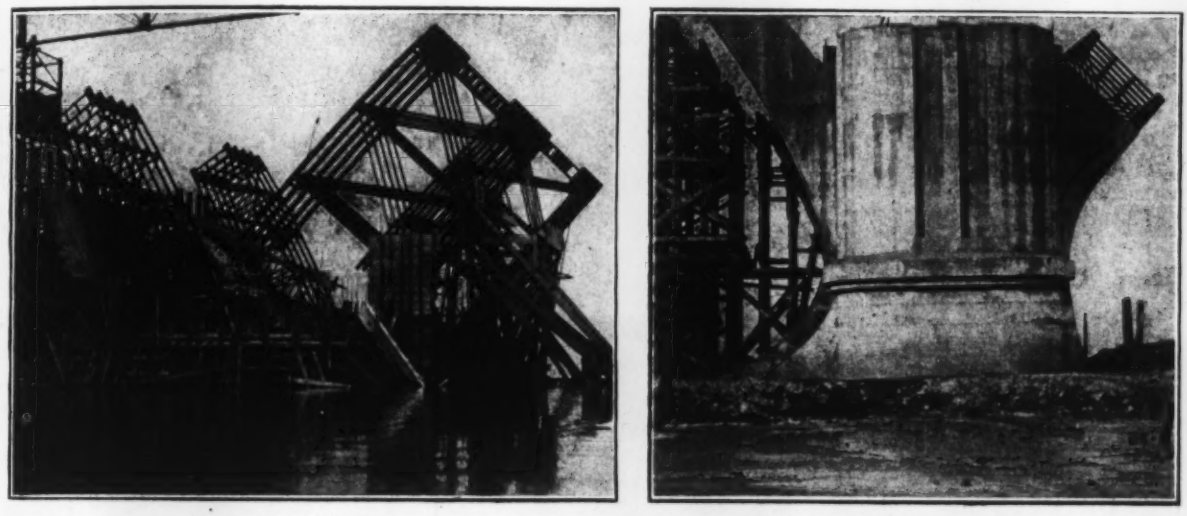


FIG. 3—RIB REINFORCEMENT AND COMPLETED PIER WITH RIB SECTIONS

It was desired to interfere as little as possible with traffic across the old bridge during construction, and to maintain at least a pedestrian crossing throughout the work. Further, the possibility of using the old bridge for transportation of material during construction was an important consideration. It seemed necessary, therefore, to clear the old structure by building outside of it, and to make the main span long enough to pass beyond the old piers.

General Design—Applying these datum points to a preliminary sketch layout, a central arch span of about 400 ft. resulted. The height of the banks called for a floor elevation some 10 ft. higher than that of the old bridge, the latter being below bank level. With a moderate grade up to the center of the new structure, then, a rise of about 90 ft. was obtainable in the central span.

In order to transmit to the sides of the gorge the larger part of the thrust of this span, it was desirable to make the side spans as long as possible. Keeping the level of their outer springing lines at the bottom of the gorge limited their span to about 200 ft., however. Under these conditions the thrust on the main piers could not be balanced, unless the side arches had been made of shallow rise by depressing the crown far below roadway level, which was not considered esthetically desirable. But a pleasing proportioning of spans was obtained, and Mr. Cappelen's skill and good taste in design soon developed this layout into the general plan

The deck width was governed by the width of the approach streets as defining the character of present and future traffic. The streets have generally a 40-ft. roadway, and this figure was adopted for the bridge. As there are other bridges reasonably near by, the nearest a mile downstream and three-fourths of a mile upstream, no very intense concentration of traffic at this crossing is looked for, and it is believed that the 40-ft. width will always be adequate. The total deck width of 60 ft. obtained after two 8-ft. sidewalks were added agreed well with the structural requirements of the arches as to width. To clear the old bridge, the arch ribs had to be spaced 25 ft. apart in the clear; a rib width of 12 ft. was considered the minimum permissible, and this brought the over-all width of the arch structure to 49 ft., leaving 5½ ft. of bracketing for the sidewalk on either side.

Arches—In laying down the general design, Mr. Cappelen had made it an initial condition that the springing line of the arches should be above high water. There is a possibility of 5 or 6 ft. of flood rise above pool level, and accordingly the pier belt course which defines the elevation of spring was placed at about this height above low water. The arches themselves are approximately parabolic; more exactly, they are curves fitted closely to the mean pressure line and then faired out by drawing three-centered intrados and extrados curves. The crown thickness of the 400-ft. arch is 8 ft. and the

skewback thickness 16 ft. The corresponding thicknesses of the 199-ft. arches are 4 ft. and 8 ft.

With these curves and dimensions, the arches do not experience any extreme-fiber tension under any conditions. The reinforcing steel could not be proportioned for definite stresses, therefore, but it was designed by judgment, to give a good interbonding of all parts of the rib. It represents about 0.8 per cent of the rib section. (See the pressure lines under half-live load, Fig. 6.)

Structural-steel reinforcement was adopted, for the sake of simplicity in erection and certainty of true positioning. Each rib contains five longitudinal frames or trusses, tied together by frequent cross-frames. The chord angles are 6 x 6 x ½ in. in the large arch and 4 x 4 x ⅜ in. in the small. The frames enter the pier concrete only far enough for bond, and do not extend to the base course (Fig. 5).

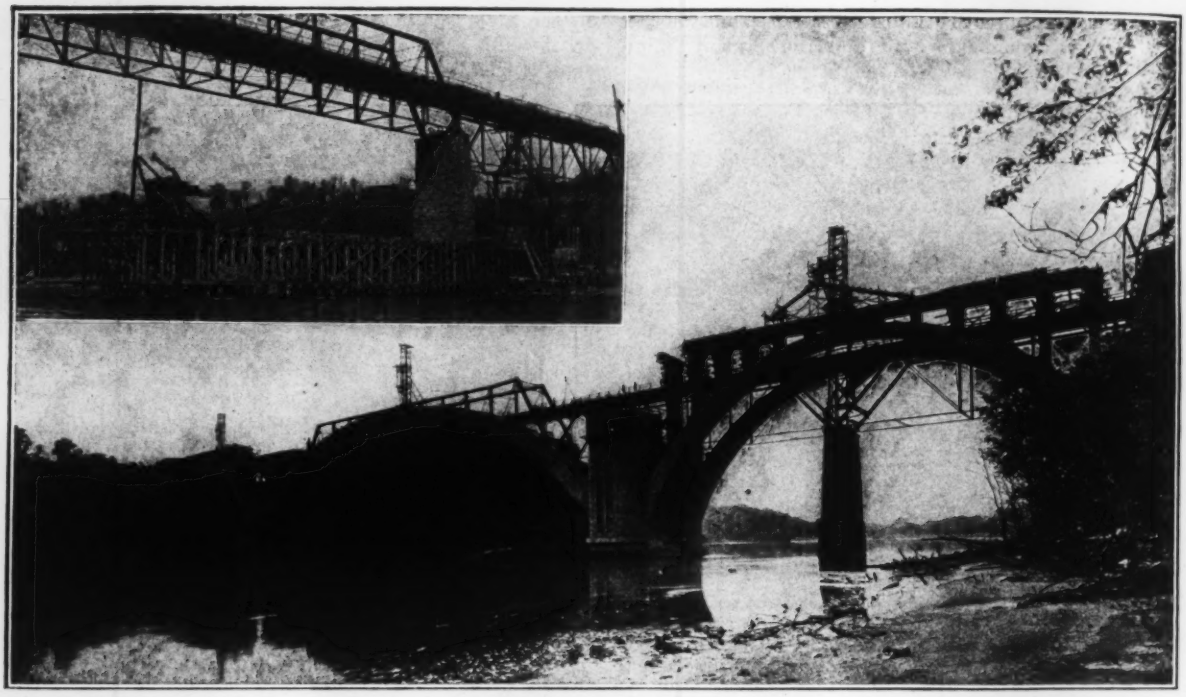


FIG. 4—THREE SPANS CROSS THE 868-FT. WIDTH BETWEEN THE MISSISSIPPI GORGE BLUFFS
The old steel bridge, shown in the insert view, was narrow enough to permit of building the ribs of the new arch structure alongside and at the same time keeping the old crossing in partial service.

Piers—It was expected that a good foundation would be found about 25 ft. below pool level. In actual construction, the west main pier was founded at 26 ft. below pool level, and the east main pier at 20 ft. The rock encountered is a massive sandstone, moderately soft, and somewhat fissured; the strata dip slightly from both banks toward the middle of the river. There being a net outward thrust on the main piers due to the excess thrust of the large arch, in order to keep the resultant pressure line as steep as possible the pier was made solid to a level well above the springing line; thence upward it carries two hollow shafts rising to roadway level. The thrust is transferred into the foundation rock chiefly by friction on the base, though there is also lateral bearing of the concrete against the rock sides of the foundation excavation, which was cut 2 to 3 ft. into the rock to get good bearing material. The base is horizontal, and no artificial keying or doweling was thought necessary to supplement the natural roughness of the rock surface obtained.

On account of the inclination of the thrust, the pier had to be made unsymmetrical in order to keep the resultant near the center of the foundation. The resulting pier design is quite unusual. There is bottom reinforcement to take care of footing tension, and skin reinforcement all around for protection against shrinkage effects. The footing pressure is about 4½ tons per sq.ft.

Construction conditions made it necessary to concrete the base course in separate sections. Care was taken to key and dowel the sections together, and a second base course extending over the whole foundation area was concreted on top of the lower or seal course, for further integration of the pier concrete.

The end piers are simple, bearing on the rock practically at the springing-line level.

Deck Design—Originally it was planned to place precast floor-beams in notches formed in the tops of the spandrel columns. Most of them are being cast in place, however, while for convenience some are being precast.

These beams, having a net span of 25 ft. and carrying a floor area of nearly 360 sq.ft., are 24 x 54 in. in section. The slab, cast over them as a separate operation, is 12 in. thick over the roadway and 9 in. over the sidewalks and will carry a pavement of wood block on sand or sand-cement fill on the roadway, and a sidewalk pavement of 24-in. square concrete tile on cinder filling.

In the original design a rather elaborate baluster handrail was planned. Precast handrail of this type that was placed on the South Third Ave. bridge has not proved wholly satisfactory, however, and it is thought

preferable to cast the rail in place. A much plainer rail, moreover, is considered quite as satisfactory in appearance as one containing ornate spindles.

Floor expansion is provided in general at alternate floorbeams, or about 29 ft. apart. The expansion end of the slab is here supported on a brass plate laid on half of the floorbeam. The curb is cast in place, separate from the floor slab. The sidewalk coping or fascia course, which also forms the face of the balustrade, is similarly cast in place.

Loading and Stress Analysis—A highway loading of maximum type was assumed in proportioning the structure. The arches were analyzed by the elastic theory as fixed-end arches, the radial springing-line joints being considered fixed. Partial loading and temperature effects were considered.

For the two street-car tracks, 40-ton four-axle cars were assumed, using the axle loads direct for the floor slab and beams, and an equivalent uniform load of 1,200 lb. per lineal foot of track for the main arches. In designing the floorbeams, one axle on each track was placed directly over the floorbeam. For designing the slab (spanning from floorbeam to floorbeam), a four-wheel truck was placed in maximum moment position (center of span at one-quarter wheel base). The load of one track was assumed to be borne by an 8-ft. width of slab, this being the width under a 6-ft. tie plus 1 ft. on either side. As the ties will be bedded in cinder concrete, an effective distribution of the rail loads along their length is expected to be obtained.

For the roadway and sidewalks, a load of 100 lb. per square foot for slab and beams was assumed outside the car tracks, and for the arch ribs a load of 80 lb. The

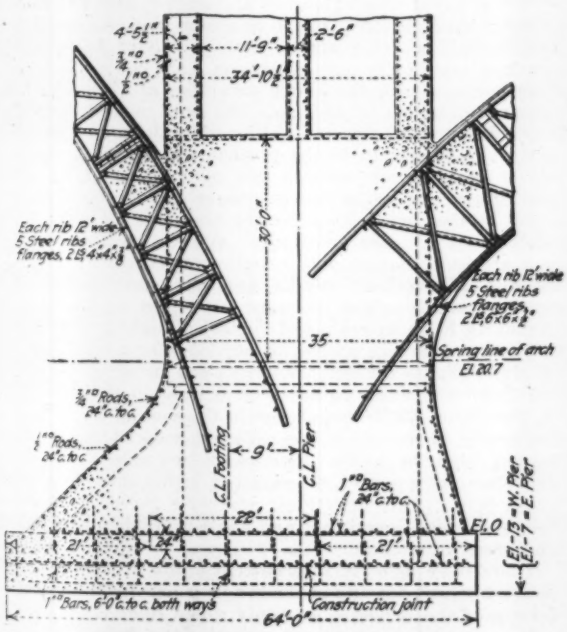


FIG. 5—MAIN PIER AND RIB HAUNCHES

width preempted by the street-car loading was taken as 20 ft., leaving a 10-ft. roadway-loading strip on either side. No impact was added to the roadway loading, but 25 per cent impact was added to the car weight in designing the slab and beams. The compression in the 400-ft. span is 563 lb. per sq.in. at the crown and 408 lb.

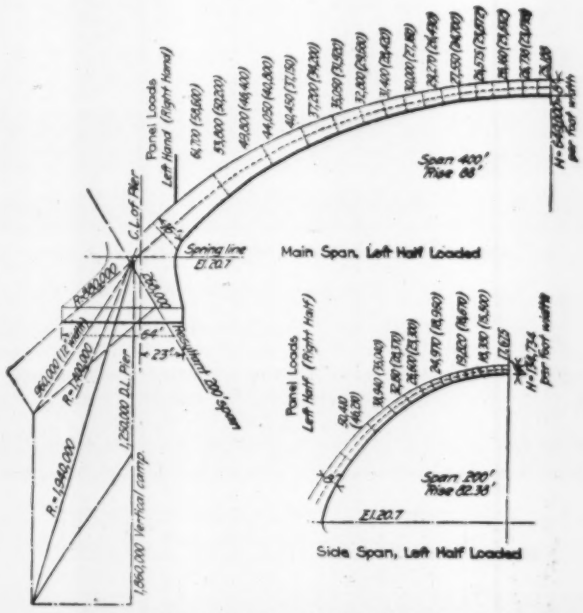


FIG. 6—PRESSURE LINES FOR LEFT-HALF LOADING

at the spring line; a temperature rise of 40 deg. would add 16 lb. per sq.in., making the maximum compression 579 lb.

The arch stresses nowhere exceed 600 lb. per square inch (compression). The slab and beams were designed in accord with the recommendations of the Joint Committee on Reinforced Concrete (650 lb. compression in the concrete, 16,000 lb. tension in the steel, and straight-line stress variation).

Construction—Construction was carried out with an interesting type of centering for the large arch, as indicated in Fig. 2, arranged for successive concreting of the two ribs. Workmanship of high quality was obtained, and the work progressed smoothly according to the schedule laid down in advance, except for the delay caused by a fire in the east portion of the main span falsework last winter, as noted in *Engineering News-Record* Feb. 9, 1922, p. 257. In spite of this the downstream (south) rib of the main arch was concreted in the last week of April and the other rib by fall. The sidewalk slabs were placed before the old spans were removed; the roadway floorbeams and floor are now being constructed after removal of the interfering parts of the old bridge.

The ribs of the 400-ft. arch settled about 3 in. while they were being concreted, due to compression of the centering. When the centers were struck, about 6 weeks later, very little further settlement took place.

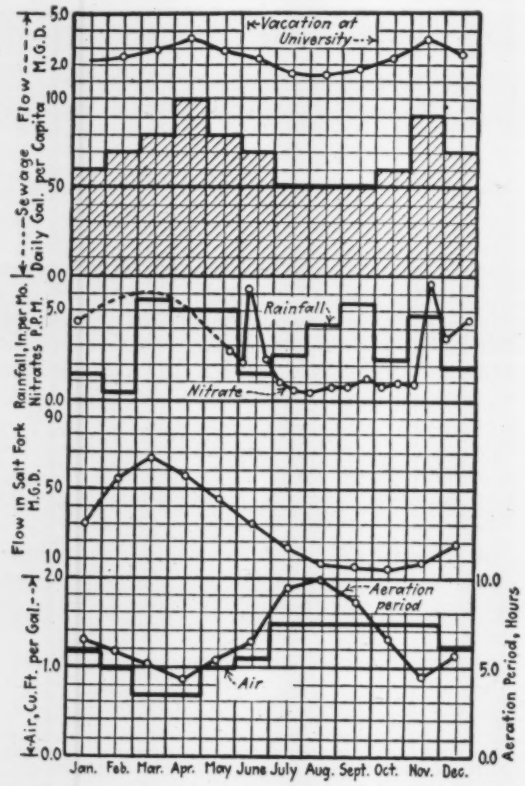
After the general design of the bridge was worked out by the late F. W. Cappelen, city engineer, the details were designed by K. Oustad, city bridge engineer. Until Mr. Cappelen's death the construction work was in charge of N. W. Elsberg. Since the latter became city engineer, F. T. Paul has been in charge of construction. J. E. Lundstrom is general foreman and Wm. McCaulley master mechanic.

Costs of materials and labor have risen since the work was begun, but it is expected that the original estimate of $900,000 for the total cost will not be exceeded. At the beginning common labor and skilled labor were paid 50c

and 80c. per hour respectively, while at present 62½c. and $1 are being paid. The total concrete in the bridge is 30,000 cu.yd., of which the two main piers consumed 5,750 and 7,250 cu.yd., the ribs of the 400-ft. arch 4,100 cu.yd., and the ribs of the two 199-ft. arches 2,900 cu.yd. The side piers, abutments and 55-ft. arches contain 4,900 cu.yd. and the floor slab 2,100 cu.yd. The remaining 3,000 yd. are consumed in the columns, floorbeams, sidewalk brackets and coping.

Imhoff Tanks and Sprinkling Filters for Champaign and Urbana

CHOICE of Imhoff tanks and sprinkling filters for the treatment of the sewage of Champaign and Urbana, Ill., instead of by the activated-sludge process, was determined largely by the smaller cost of the former method. Estimates for each plan were made up on the basis of (1) electric power, purchased, and (2) oil engines, installed by the city. Using purchased



FACTORS AFFECTING AERATION PERIODS OF PROPOSED CHAMPAIGN-URBANA SEWAGE-WORKS

Based on estimated quantities in 1925, with reduction in air requirements in spring due to sewage dilution at that time. High nitrates also reduce air required in accordance with experiments of Dr. Edward Bartow.

power, tanks and filters were estimated to cost $400,000, with an annual operation cost of $16,800, making a total annual charge of $46,800. With oil-engine power, the first cost would be $410,000, the annual operation cost $14,200, and the total annual charge $44,950. For the activated-sludge plant, purchased power would require an outlay of $300,000, a yearly operating cost of $44,000 and a total charge of $65,500. If oil-engine power were used the first cost of an activated-sludge plant would be $345,000, the operating expense $33,800 and the total annual charge $69,600. It was these figures that led Pearse, Greeley & Hansen, consulting engineers, to decide on tanks and filters rather than activation, since either method would be satisfactory. The electrical power was figured to cost an average of 2.9c. per kw.-hr. Few, if any, activated-sludge plants in this country, the engineers mentioned state, have been built where the cost was more than 1c. per kilowatt-hour.

In the accompanying chart are shown factors affecting aeration estimated for the 1925 capacity of 2.5 m.g.d. and it was on the required air per gallon that the final figures given above were based.

The sewage-works will be built by the Urbana and Champaign Sanitary District and paid for by a $500,000 bond issue. In the election campaign for these bonds well prepared booklets were distributed to help win the support of citizens and taxpayers.

Lighting Highways and Motor Vehicles

By David Beecroft
Vice-President, North Atlantic Division, National Highway Traffic Association

Extract from a paper presented at joint meeting of the North Central Division of the National Highway Traffic Association and the Michigan State Good Roads Association.

CONNECTICUT has gone further than any other state in a study of accidents and for two years has investigated every accident occurring on the highways of the state and has classified these accidents showing the number for which the blame is due to motor cars, motor cycles, trolley cars, horse vehicles, railroads, pedestrians, etc. This analysis for 1921 shows that approximately 91 per cent of all accidents on the highways can be eliminated by highway improvements, better highway lighting, improved signals, better lighting of motor vehicles, improved regulation of all vehicles and general education of those using the highway. The Commission of Motor Vehicles believes that only 7 per cent of all highway accidents cannot be avoided.

After reading the opinions of motor vehicle commissioners, in half a dozen states, that now have heavy motor truck travel, only one conclusion can be reached, viz: that perhaps with the single exception of Connecticut no adequate analysis of accidents has been made to establish any relationship between lighting of vehicles and the accidents. Perhaps up to the present we represent the consensus of opinion by stating that motor cars are too often overlighted and motor trucks generally underlighted.

Let us now briefly consider the highways on which these vehicles operate day and night. A few stretches of highway are being lighted with experimental systems, that give promise of excellent results and our state departments must keep this subject in mind as a part of the problem of making highways safe and the task of highway regulation.

The las' year has witnessed rapid development in the use of signal lights at street intersections in suburban areas. No uniformity exists in the color or location of these lights. In one city of 40,000 population in the zone of Greater New York city there are three different colored lights on a leading highway in the distance of two miles. All three are blinking types of intermittent lights, one showing a green light in both directions; another a green in one direction and white in another; and another red in one direction and green in another.

There is no field for intermittent lights of this character on the highway because of the tax they impose on the mental energy of the driver. A steady green light is preferable.

In a night trip of 20 miles north from New York City, and in other directions as well, the driver is confronted with a veritable chaos of lighting schemes, each of which demands a mental problem at a time when the driver is approaching a danger zone and when most of his mental alertness is needed in watching other users of the highway and controlling his vehicle. All highway signal lights of this character should be standardized not only as to color, but as to height and location.

Studied Economy Is Trend in Modern Road Work

Highway Planning, Design, Construction, Maintenance, Administration Demand Strict Business Principles, As Shown by Abstracts of Road Builders' Papers, Read at Chicago Jan. 15-19

Keep the Public Sold on Highways

By H. E. Hilts
Acting State Highway Engineer of Pennsylvania

A STUDY of the history of transportation shows the necessity for leadership and vision. New ideas in transport, like all other commodities, have to be sold. Our present day commercial transport is sold and our interstate and intrastate carriers sell their particular facilities to their clients both by publicity campaigns and by paid agents.

In the field of highway transport, a new mode of common carriage has rapidly developed. It is still young and is still in its pioneer stage of development. It is a mode which, if used and promoted conservatively, will augment, simplify and make more economical and commercially more remunerative both ship and railway transport. If, however, its powers are spent in endeavoring to usurp the functions of the other carriers, it would seem that our new mode of transport will be retarded in its development. Education will help to prevent this danger. In common prudence state highway departments should play their part in giving the public authoritative information on highway transport, as it involves the roadbed and the right-of-way.

Broadly speaking, pay transport is that of the manufacturing and commercial interests, and these interests have to be sold (1) the idea of selective carriage by the motor truck on our highways in contra-distinction to the common carriage of the railroad, and (2) the use of the motor vehicle for short-haul traffic. In general, the commercial interests are exponents of the value of good roads, but there has been a marked laxity on the part of the state highway departments in giving out information which is live information, and the spasmodic attempts by personal address have not carried the message of economical use to these people. The road builder, the motor truck manufacturer, and the railroads have a common interest in selling the road user reasonable selective traffic, and the sale of the idea that a reasonable load should be carried within the legal limits of speed, and in a vehicle that meets all legal requirements.

The largest class of road user, the owner of the pleasure motor vehicle, has as yet to be sold the salient idea of highway financing. He does not yet realize that roads cost money, that definite road policies of construction, maintenance and administration are necessary. He does not realize that he has a vehicle that is dangerous to his fellow man when improperly used. The courtesy of the open road has not as yet made its appearance. If the road official does not take in hand and continually sell and resell the idea of road courtesy, he is leaving one of his greatest assets dormant.

The obligation of the state highway department is not fulfilled merely by selling ideas, for before it can sell anything, it, like any other business enterprise, has to have the healthy respect of the general public for its purposes, its judgment and its work. If the people are led to believe that its purposes are political, that its judgment is biased and its work is poorly handled and wastefully done, it can't sell ideas. Therefore, when the general policy of a live department is decided upon, after definite and long continued conferences with the people and with the interdepartmental divisions, let the people know—don't hide it. Expenditures are large, tens of millions of dollars yearly in many states, and the making available of funds in future years will be one of the jealous prerogatives of future legislatures. State programs always will depend upon the legislatures as representing the will of the people; therefore, public opinion should be courted.

Probably one of the most important policies, and one on which the public must be not only sold by telling, but repeatedly sold by retelling, is that of correlating construction with maintenance. A workable theory is that maintenance means not only the maintenance in the densely populated states, of the old roads, but also the improvement by current revenues of the rural roads which are in a primary system, and which are not yet susceptible to the expenditure of bond moneys for their improvement.

When the maintained main routes become increasingly burdensome year by year, not only on account of maintenance or other expenditures, but also on account of burdensome hindrance to economical vehicle or transport operation, then correlate these sections by durable construction. This correlation means a detailed study month by month, and year by year by the maintenance and construction engineers; it means study not only in the field, but also in the office after yearly charges have been segregated. An annual program involving 500 miles of resurfacing year by year; surface treatment of 1,800 miles a year, and construction of durable types at the rate of 500 miles a year must need be correlated, so that economical expenditures may be planned and made, and the details of a program of this character have to be sold to the public through the press, and by pointed constructive talks and lectures. The public must be made to realize that highway work is a great continuing business, and one which cannot be tampered with.

Sales are not all accomplished by cold type and conservative oratory. The most convincing public official I have ever met did not look upon visitors at headquarters as pests or ingratiating individuals who called because they wanted something. To him they were the individuals through whom he could talk to hundreds, to him they appeared as the representatives of their districts, and he would spend hours in conference, enlarging upon viewpoint after viewpoint, and gradually drawing their interest closer and closer until there was mutual understanding.

The total yearly volume of sales of a state highway department to the people of a state is anywhere from $12,000,000 to $45,000,000 per state, striking an average of say $20,000,000. Can we gather any light by comparing this average department with an efficient corporation doing this gross business a year? Does the corporation spend money to make sales, does it spend money to create desire for goods, does it spend a conservative sum for research and for increasing the efficiency of both the employee and the plant, and when all is said and done are these sums conservative with the ends achieved? You will say yes. Analyze the county or state highway department. Does it usually make any effort not to spend money for publicity purposes, but to create desire for roads through channels that are opened freely to them, does it allow in its budget anything for research or refined design practice, or does it organize for efficient publicity work? Most of us will admit broadly—no. Still when the public asks as to taxes, indifferent service, poor maintenance, misinformation, inferior detours, unanswered construction complaints, and all the other miscellaneous complaints that buzz throughout the year, we find that they all can be summarized to come under the broad general publicity outline. The only conclusion that can be drawn is that we haven't still perceived the business man's viewpoint.

Enthusiasm must be created for our work, our job and the things yet to be accomplished, because in the end it is the spark of enthusiasm that sells or builds or creates great enterprises.

Designed Subgrade

BY C. M. UPHAM
State Highway Engineer, Raleigh, N. C.

THESE facts in connection with subgrade design may be conclusively stated:

1. The bearing power of nearly all soils is increased when the moisture content is decreased.

2. The bearing power is affected more by moisture in some soils than in others.

Therefore, the first two principles in the design of subgrades are the regulation or exclusion of water and the selection of a subgrade soil or material that has the highest bearing power and is least affected by moisture.

In selecting soil for subgrades, it is desirable to select a material that will have a high bearing value, even though it has become saturated with water. Generally speaking, the coarser the material up to a certain practical size for working, the less the capillary saturation and the greater the bearing power. Experiments have shown that a layer of coarse material such as sand or gravel, when placed over clay, retards the capillary water from rising to the top of the subgrade, or in the case of soil roads, to the top of the surface; from which it may be seen that the value of the design of the subgrade not only depends on the regulation of moisture but on the selection of the subgrade material as well.

Any system of drainage that will prevent water from finding its way to the subgrade will suffice or serve as a means of freeing the subgrade of the water that does by chance find its way there. Generally the solution is found in the selection of subgrade material and a combination of ditches and underdrains. Care should be taken that the ditches are only of a sufficient depth to lower the water table and are located far enough from the traveled way to interpose no hazard to traffic.

If side or longitudinal ditches are designed properly it seldom happens that longitudinal pipe underdrains are necessary, for the open side ditch will perform all the drainage functions of such drains.

Assuming that surface water may be cared for by ditches, and that water in the subgrade from springs and other sources may be relieved by underdrains and ditches, the problem of caring for capillary water still remains. The most satisfactory way to cut off capillary water is to introduce a layer of material of low capillary value, or, in other words, a material through which the passage of the capillary water will be retarded. This often can be accomplished by selecting in the grading of the road, material of low capillarity and using it for a subgrade on which will rest the hard surface, or in the case of soil roads, for that portion used by traffic. It often happens that it is more economical to borrow material, the bearing value of which is least affected by water, for the subgrade, and it sometimes may be desirable to waste materials from cuts, and borrow satisfactory material for the fills. Too much stress has been laid on the balancing of quantities and too little stress has been laid on the selecting of material entering the subgrade.

* * *

Immediate Tasks of Highway Research

BY W. K. HATT
Director, Advisory Board on Highway Research, National Research Council

TO expedite the collection of authentic data on the basis of which highways may be wisely selected to meet the economic needs of the region, properly built to conform to the economics of the situation, and operated in the interest of the public, the immediate necessities are:

1. Many problems in highway engineering are accompanied by corollary problems in economics of highway transport. What sum may profitably be spent in capital costs of construction to reduce a grade? The answer must depend on volume of traffic and on operating costs of road and vehicle. Again, decisions upon changing second-class into paved roads involve cost of road maintenance, tires, gasoline, and repairs and depreciation to vehicle, etc. Reliable data appear to be largely wanting. Research activities should be pushed.

2. The study of methods of financing road construction, and the distribution of the expense between those benefited, await fact-finding surveys. The study itself needs the services of trained economists. The source from which the tax dollar comes, and its distribution among roads, education, charities, etc., should be determined.

3. Studies of the effect of highway improvements on land values are needed; and also of the effect of highway improvements upon industry and the development of typical regions, such as truck farming or resort areas. The result of such studies will be a guide for similar areas under development.

4. The laws governing the growth and dispersion of traffic, and the mechanics and psychology of safely handling such traffic in congested areas, need study by research methods.

5. The purpose and methods of, and the instrumental equipment for, basic traffic surveys upon which state construction and maintenance funds may be allocated are live issues. A simple instrument for automatically counting and weighing traffic is now under development in the Bureau of Public Roads.

6. The large volume of valuable data, accumulated at the cost of hundreds of thousands of dollars, through studies of soil properties, effect of loads and strength of slab—data that underlie the as yet undisclosed principles of the mechanics of slab design—should be brought together and analyzed to uncover the principles of action. The instrumental equipment and technique in this field represent a remarkable advance in the science of measurement. With the mechanical principles determined, then the engineer can be given formulas for fitting the road to the load. If these principles are still hidden, final co-ordinated researches should be planned to settle these questions. If it is true, as it seems to be, that stiff slabs on soft subgrades should be thick at the edges and thinner at the center, what should be the proper distribution of the thickness, and how should slabs be reinforced to provide longitudinal stiffness?

7. The economies of pavement types in specified situations must be learned from carefully gathered data, so that decisions may be made less upon ex-parte arguments and more upon exact information.

8. The findings of laboratory tests upon materials of construction should be scrutinized in the light of experience in operation to determine to what extent these tests are predictive of service value in the road.

* * *

Hot-Mix Asphalt Sand Roads

BY VERNON M. PIERCE
District Engineer, Bureau of Public Roads

WHERE sand is the only available local road material, it may be quite practicable economically to construct a high class highway.

A considerable portion of the country along the South Atlantic coast, for example, has very little stone for road-building, although there is an abundance of sand. These localities are generally so situated that freight rates which govern the delivery of stone are prohibitive. A solution of the problem has been secured by the construction of a hot-mix asphalt sand road in the vicinity of Wilmington, N. C. First a survey was made of sand deposits in the vicinity of the proposed road and a product selected which most closely approximated a sheet asphalt sand grading. A portable asphalt plant was then erected at the deposit for preparing the mix. The roadway was graded in the usual manner. Cypress stringers, 2x8 in., were firmly staked along the sides as forms and were left in place to protect the edge of the road under traffic and to keep the foundation confined. The subgrade was thoroughly compacted and upon it was then placed a foundation course 3 in. thick after compaction of a mixture of sand with about 7.5 per cent of asphalt cement of approximately 45 penetration. Upon this

base a surface or wearing course having a compacted thickness of 1½ in. was then laid, which course was composed of sand, mineral filler and asphalt cement in such proportions as to approximate a standard sheet asphalt surface mixture. In this vicinity and under favorable conditions such a road can be constructed at less than $1.25 per square yard and answers the problem of a low cost road in an undeveloped section where hard surfaced roads are necessary for the development of the country.

Deposits of marl are of frequent occurrence along the South Atlantic coast and this material when locally available makes a most excellent foundation for a hard surface wearing course. Within a few miles of the road referred to above in North Carolina a 1-in. wearing course of the sheet asphalt surface mixture has been placed on an 8-in. compacted marl base at a low cost and promises to be very satisfactory to meet all needs for years to come.

* * *

Progressive Construction—Iowa Practice

BY C. C. COYKENDALL

Assistant Chief Engineer, Iowa State Highway Commission

THE State Highway Commission, created in 1904, was vested with only advisory powers. Counties commenced building bridges and culverts of permanent construction and cutting down hills and filling hollows adjacent thereto. Toward the close of this period (1904-1912) the use of large blade graders drawn by gasoline tractors became quite general, resulting in the building of a considerable mileage of dirt roads to a natural grade, and to sections closely approaching present day standards.

In 1913, radical highway legislation reorganized the State Highway Commission, clothing it with drastic supervisory powers, and providing adequate funds for its support. The state continued its policy of non-participation in the cost of road building, but required all highway construction work, both road and bridge, to be done in accordance with plans and specifications either prepared by or approved by the State Highway Commission.

Under this scheme of operation, by the end of 1916 approximately 1,600 miles had been built to established grade in accordance with approved plans; approximately 25,000 bridges and culverts had been constructed of so-called permanent construction; practically the entire mileage of the county road system—some 15,000 miles in all—had been constructed to natural grade and standard section and was being rather systematically maintained.

Federal participation in highway building necessitated further changes in 1917 and 1919 in Iowa's highway laws. A limited trunk line system of approximately 6,600 miles was designated as the primary road system, upon which all federal aid allotted to the state, and all revenues derived from licensing motor vehicles, must be expended. The remaining mileage of highways was classified as secondary roads, approximately 11,000 miles of which constitute the county road system, and the remaining 87,000 miles still being under the supervision of the township officials.

Under this revised legislation the improvements undertaken on the primary road system consist largely of completing the construction of roads to established grade, providing the necessary drainage and drainage structures, and when this has been completed, surfacing with gravel or sand-clay construction.

On Dec. 1, 1922, of the 3,653.5 miles of the primary road system that had been constructed to established grade and the necessary drainage and drainage structures provided, 334.4 miles had been paved and 1,558 miles had been gravel surfaced, leaving 1,761.1 miles without surfacing of any kind. A large percentage of the mileage that has been gravel surfaced will need to be paved some time within the next decade if traffic is to be adequately served. In the meantime, however, traffic on these 1,558 miles of gravel surfaced highways is getting reasonably efficient highway service, whereas the same funds invested in pavement would have given traffic a high grade of highway service on only approximately 150 miles.

Progressive Construction—North Carolina

BY C. M. UPHAM

State Highway Engineer of North Carolina

THE North Carolina method of progressive construction is to grade the road, using the same standards for line and grade that are used in hard surface construction. Only one standard of drainage structures is used regardless of whether the road is merely graded or is to be covered with a hard surface. This construction of graded road will care for the light traffic which generally exists in all newly developed localities. This graded road is at all times maintained and when the increased traffic creates a high cost of maintenance, then it is indicated that it is time to construct the next higher type of road surface. The next step in the progressive type road is to cover the graded road with a selected soil material, such as sand-clay, topsoil or gravel. This material is generally of higher bearing value than the natural soil, and is a material which is less affected by moisture and therefore more suitable for use as a road surface. This selected surface material is maintained as a subgrade highway until such time as the maintenance cost becomes excessive and the increased traffic indicates that a hard surface roadway is necessary.

The cost of grading and the drainage structures generally constitutes about one-sixth of the ultimate cost of a hard surface road. To add a selected soil surface adds very little difference to the cost of this construction; consequently about six times as much road, with a selected soil surface, may be constructed for the same money as though the money was spent for the immediate construction of hard surface roads. This makes it possible for transportation to be benefited to a much greater extent and the state to develop at six points rather than at one.

It will be noted that the construction of the selected soil surface is an addition to the graded road, and no previous step in the grading or construction of drainage structures has been lost or thrown away in the construction of this selected soil surface road.

In the progressive type road all steps taken in its construction include the utilization of all previous construction when transforming the road to the next higher type, and each step may be considered as a subgrade for the next higher type surface. This in itself justifies the expenditure of a sufficient amount of money to select soils of a character which may, with proper maintenance, be used as a surface material until such a time as traffic demands, or the cost of maintenance makes it necessary to construct the next higher type of hard surface. By this method of construction the graded road or the selected soil surface can truly be called a subgrade highway, and is often the economic solution for road construction over a large portion of a state system.

The ultimate step in progressive type construction is the addition of the hard surface. After the maintenance on the selected soil surface becomes excessive or when the country and traffic develop to the extent that a hard surface road is necessary, the next step is to construct the hard surface pavement directly on the selected soil surface. This method of progressive construction utilizes advantageously the selected soil surface as a stabilized subgrade for the hard surface pavement, and on account of the complete settlement, and on account of the character of the selected soil surface, the subgrade is stabilized sufficiently to aid the hard surface in carrying the loads.

Therefore it may be seen that with the construction of the progressive type road, light traffic or a small tonnage is cared for by a graded road of comparatively low cost. As the traffic demands and tonnage increases, the road is increased in strength, and the increase of the investment is justified. As the traffic and tonnage increase to the maximum, a hard surface road is constructed. The construction of roads on progressive principles means that the greatest percentage of the invested money is in permanent construction, and justifies the expenditure of bond money in any progressive type road.

North Carolina has constructed many progressive type roads. It has already completed its cycle by placing hard

surfaces on roads which were previously graded and stabilized with a selected soil material, although at present it has a reasonable mileage of graded roads in the newly developed localities; it is maintaining as subgrade highways a large mileage of selected soil roads and thus affording a means of traffic to a great portion of the state. The completion of about 400 miles of hard surface construction in 1922, many miles of which were hard surface added to progressive type roads, demonstrates the complete and satisfactory manner in which the progressive type road is caring for the traffic in North Carolina. It shows that this method of road construction is no longer in the experimental stage but is economically and practically sound.

* * *

Restoring Macadam Roads

By W. A. Van Duzer
Assistant Maintenance Engineer,
Pennsylvania State Highway Department

BEFORE the actual operation of macadam resurfacing is taken up the depth of stone in the existing roadway is established by actual measurements. Test pits are excavated to the bottom of the stone in the center and measurements are taken on each side for a distance of half the width of the road. These pits are dug every 25 to 50 ft. The base is then widened out, and in places where sufficient foundation is not shown stone is added to secure the required depth. Then the road is scarified lightly and reshaped with a road machine. The base is brought to a true cross-section and grade by the use of a crown board and steel pins are driven every 10 to 20 ft. depending upon the profile and a cord stretched along the edge and to the top of the proposed ballast. Berms about 4 ft. in width and from 1 in. to 2 in. above the line are then built up.

Waterbound Resurfacing—More satisfactory results are obtained by the use of 1½ to 3 in. stone for waterbound macadam resurfacing. The material is dumped upon the sub-grade and forked, thus eliminating the danger of the segregation of the sizes, which is the cause of a great deal of subsequent patching. The stone is built to a crown board and then thoroughly locked with the roller after which the screenings are applied fanwise with a shovel and rolled until the voids are thoroughly filled. The water is then applied and the road rolled until the mortar is flushed or puddled and the road is then allowed to set before surface treatment.

The maintenance of the road during the time that it is setting consists principally of sweeping, either by caretakers or lightly by mechanical brooms or horse-drawn sweepers. The sweeping is done first to remove the caked or matted screenings from the edges, which must be done in order that proper penetration of the surface treatment material may be obtained, and second to replace these screenings in the center of the highway from which they have been removed by the action of traffic.

Surface treatment—Previous to the first application of the bituminous material, the screenings must be removed by sweeping so that the voids will show between the ballast to a depth of possibly ¼ in. Material must be applied in two applications with a pressure distributor, the first to be approximately ⅛ gal. to a square yard and the second from 1/10 to ¼ gal. In some cases ⅓ gal. will penetrate the road from ¼ to ⅜ in., this penetration depending upon the kind and the cementing value of the stone.

The second treatment should be a high viscosity bituminous material, the quantity just sufficient to properly fill the voids and this can only be determined by experience, but in most instances varies from 0.25 to 0.3 gal. per square yard. Hard stone chips, from ¼ in. to 1 in. in size, dustless and free from dirt, should be used as a covering at the rate of from 20 to 30 lb. per square yard, or approximately 1 cu.ft. of stone chips to 1 gal. of bituminous material. Owing to the large chips used and to assist in compressing them into the bitumen, the treatment should be rolled with either a 5 to 8-ton tandem or a 10-ton macadam roller, as soon as the chipping is completed, but if a material that does not dry rapidly is used, equally good results can be obtained if the road is rolled from 24 to 36 hours after the bituminous application.

The third treatment may be either a high viscosity coal tar, water gas tar, or asphalt, or as an alternative, a hot material. We apply from 0.15 to 0.25 gal. per square yard of the hot material which requires from 30 to 40 lb. of chips. This treatment must be watched carefully as the road will bleed after being thrown open to travel and, if not given proper care, will pick up under tire wagon traffic. Stone chips for covering give the best results.

Bituminous Macadam Resurfacing—After the road has been brought to a true cross-section, approximately 3 in. of stone, varying in size from 1½ to 2¾ in., is spread to a depth of 3 in. This is locked by rollers and then the bituminous material is applied at the rate of 1¾ to 2 gal. to the square yard, depending upon the kind of material used. Stone is uniformly spread, varying in size from ¾ in., which is properly rolled and a seal coat of from ½ to ¾ gal. per square yard of bitumen is then applied and chips of approximately ½ in. are spread over the surface. The road is then rolled until it is properly bonded.

Unbound Macadam—The method usually employed in the construction of unbound macadam is to scarify the old road surface, shaping it up with the road machine and rolling until a firm foundation has been obtained. Stone, clear of dust, varying in size from ½ in. to 1½ in. is piled along the side of the road. Just ahead of the distributor, the stone is spread uniformly to a depth of approximately 2 in. Where possible, traffic is kept off, or at least confined to one side. Then apply from ⅜ to ⅝ gal. per square yard of bituminous material with the proper penetration, or a larger amount where two applications are made, which is governed by the depth of the loose stone and is varied accordingly. The material is allowed to dry for from one to three days and is then rolled.

* * *

Salvaging and Maintaining Macadam

By Alex W. Muir
Superintendent of Maintenance, New Jersey
State Highway Department

IN preparation of the base, due to the improper use of bituminous materials in surface treatment, many roads have accumulated a thick, unstable bituminous mat. This mat must in all cases be entirely removed before laying the new surface, or failure will result due to the pushing of the old mat.

Waterbound Resurfacing—The stone advocated for waterbound resurfacing is as large as or larger than that which for years was used for the base course only. Great care must be taken to have the stone uniform, for pockets of fine stone will ravel during the period of curing and require additional work to rebind, and will even then result in blemishes in the surface. In estimating on the cost of work with this grading of stone one-half as much screenings as stone will be required. Too great emphasis cannot be placed upon the necessity of using screenings which are free from strippings and other foreign matter.

Surface Treatment—Emphasis should be laid upon the necessity of thorough removal of screenings by sweeping prior to the first application of bituminous material. Under no conditions must the bituminous material be applied upon a surface which is damp. The temperature of the atmosphere when the material is applied has a great effect upon the results. It is possible to do surface treatment work prior to June 1 and it is also possible to do it after Oct. 1. If, however, the work is confined to June, July, August, and September, very much better results will be obtained and it is probable that still better results would be obtained if the season could be cut down even more. Atmospheric temperature also is a determining factor in the grade of material which can be used on this work. During the height of the summer season excellent penetration will be obtained from a material of the consistency and general characteristics of Tarvia B and Ugite B. These materials are, however, of too high viscosity to give a penetration of any account

under ordinary weather conditions after the first of October; it then becomes necessary to resort to a material having an even lower viscosity.

In Pennsylvania practice the first application of material is approximately ½ gal. per square yard; the second application from 0.2 to ½ gal. per square yard and the third treatment from 0.15 to 0.25 gal. per square yard in accordance with the needs of the road. These quantities, it will be noted, are considerably less than is the common practice in surface treatment work and are, the writer believes, one of the secrets of the success of surface treatment work in Pennsylvania.

In Pennsylvania they do not ordinarily apply any covering to the first treatment. This procedure is undoubtedly desirable from the standpoint of the results to be obtained, but experience in New Jersey has been that the travelling public raises such strenuous objection that it is necessary, as a matter of policy, to apply covering material which should, however, be kept to the minimum. Mr. Van Duzer states that stone chips give the best results. Experience in New Jersey indicates that equally good results may be obtained by the use of crushed slag for cold surface treatment work. Great care must, however, be taken to obtain slag of a high quality. Our specifications for slag in New Jersey briefly are as follows: "All slag must be air cooled, have a fresh, clean surface, free from mud, dirt, clay or loam. It must not be brittle or glassy or have an apparent specific gravity greater than 3.0 at 15.5 degrees C. It must weigh not less than 70 lb. per cubic foot loose measure, and be free from decomposed products."

Bituminous Macadam Resurfacing—The salvaging of old macadam bases is unquestionably a matter worthy of more serious consideration than has ordinarily been given to it. Given a good subgrade and drainage conditions, a good stable macadam base represents an investment which should not lightly be discarded. It should not, however, be taken for granted that any macadam can be successfully treated in this manner. Before adopting such a procedure a thorough investigation should be made of all factors effecting the proposition.

* * *

Blade Grader Road Maintenance

By W. H. Root
Maintenance Engineer, Iowa State Highway Commission

THE most useful and indispensable tool for the care of earth roads is the heavy blade grader, a machine with a blade length of from 12 to 16 ft. heavy enough to do work that will require 30 to 50 drawbar horsepower. A blade grader with a back sloper attachment is preferred. This is an attachment which may be bolted on the end of the blade so that the ditch bottom and back slope may be cut at the same time as the inside slope. A properly designed back sloper will cut the ditch and back slope when the main blade is cutting the inside slope. The device should be adjustable so that the back slope can be flattened from 1½ to 1, to 2 or 2½ to 1 where extra dirt is needed.

No two miles of road require the same treatment, and the cost of blading, therefore, varies greatly. The following figures, however, roughly represent the cost of the average mile.

1 engineer, 25 hr. at 75c.	$18.75
1 grader operator, 25 hr. at 60c.	15.00
125 gal. of gas at 22c.	27.50
Oil and grease	3.00
Depreciation on a $6,000 investment figuring a 3-year life of 100 working days per year—2½ days at $20 per day	50.00
Estimated repair 2½ days at $5	12.50
Interest on investment (5% on $3,000) 2½ days at $1.50	3.75
Clearing right-of-way and incidentals	19.50
Total	$150.00

Earth roads are divided into patrol sections of about 10 miles each. A patrolman is usually equipped with a grader, a drag, a slip scraper, a plow, and a set of small tools. He also has access to other equipment such as wheel scrapers, mowers, etc. He furnishes one team all of the time and in most cases has a second team which can be procured when needed. On the heavy soils four horses have to be used even on a small grader.

Metering Road Service to Users

By J. N. Mackall
Commissioner of Roads, Maryland

THERE could perhaps be no more unscientific and inequitable way of measuring to the users of the roads the benefits they derive from them than the present method of motor vehicle registration existing in most of the states.

If the highway departments are going to say, and they generally are saying, that registration of motor vehicles is going to pay the cost of maintaining the improved roads in every state, then they must see that legislation is enacted which will make this burden fair and just to all. This cannot be done unless it takes into consideration the service obtained by users of the road.

If the railroads meter the service which they render to the public and charge a fee for it, depending upon the mileage travelled, and if the telephone company renders a specific service for a specific fee, varying with the quantity of service, and if the gas company, the electric light company and the utilities generally put in your house a meter which will measure the service which they render to you and bill you accordingly, then shall not the highway departments meter to the traveler the service which he has received from the roads and bill him accordingly? Certainly, this should be done if it can be done scientifically, economically and satisfactorily.

The metering to a vehicle the service which the road renders to it, regardless of whether it is at home or abroad, can be done in a perfectly simple manner by levying a tax on gasoline. The tax on motor fuel will not meter to the travelers with exact accuracy the service which they receive from the roads, but it will measure that service more accurately than it has ever been attempted. It takes into consideration the weight and speed of the vehicle, and the distance traveled, the elements which cause wear and tear; but it does not take into consideration the cost or value of the vehicle, or some theoretical horsepower rating. These latter are elements which do not cause wear and tear and have no bearing upon the service which the roads render.

It is conceded that pneumatic tires actually do much less damage to the road than solid tires. Therefore the solid-tire vehicle should pay a fee over and above the tax on motor fuel, but again is there not room for equalization? Rather than to charge, as is done in most states today, a definite fee based upon the carrying capacity of the vehicle, should this not be on gross weight? If we concede that weight is an element of wear and tear upon the road, then does it make any difference whether that weight is in the chassis or in the load, provided, of course, it is equally distributed in any event? As further evidence of the need for change in registration, we find most states licensing today upon the basis of either horsepower or of carrying capacity, and relatively few basing it upon the actual weight of the truck and load combined. In addition to the regular tax on motor fuel, there should be a fixed fee charged for the registration of motor vehicles varying with and based on the total weight of vehicle and load combined.

In conclusion, it would seem therefore, that if we can abandon quickly present unscientific and inequitable methods of metering to the user the service which he receives from the road, such as registration based upon horsepower, combinations of horsepower and weight, combinations of horsepower and costs, and substitute for them the tax on motor fuel for all pneumatic tire vehicles, we will be measuring this service almost as accurately any public utility measures the service which it renders to its patrons.

If in addition to the tax on motor vehicle fuel, we will place an additional charge against the users of solid tire vehicles, based upon the combined weight and carrying capacity of the vehicle, we will have reduced this to an almost scientific accuracy.

Vehicles other than those propelled by internal combustion engines, equipped with either solid or pneumatic tires, which are almost a negligible percentage of the total, can be registered on the basis of total weight for both pleasure and commercial vehicles.

Highway Abuses and How They May Be Eliminated

Financing, Design and Construction Abuses Precede Completion; and Uncontrolled Traffic Abuse Follows It

By Thomas J. Wasser
State Highway Engineer of New Jersey

Extracts from the presidential address before the American Road Builders' Association in convention at Chicago, Jan. 16-19, 1923.

OFTEN the greatest abuse that comes to our highways occurs prior to completion. Failure to finance wisely, faulty judgment as to type and width of pavement and choice of location to suit certain interests are common abuses of the highway before it is built. In detail some of the items are:

1. Making the term of bonds longer than the life of a pavement.

2. Failure on the part of the engineer to provide a design and type of construction to meet the requirements of modern traffic.

3. Faulty construction on the part of the contractor for personal profit.

4. Inefficient inspection due to lack of knowledge, and to insufficient salary being paid to attract capable men.

5. Acceptance of inferior work.

6. Permitting inferior material to be substituted for that specified when delays are brought about by conditions beyond the control of the contractor.

7. Sacrificing quality for speed.

8. Failure to provide for a satisfactory well marked and maintained detour during the period the highway is under construction.

9. Designing and building bridges for a live load less than that for which motor vehicles are licensed and narrower than the graded width of the highway.

10. Failure to provide for the elimination of railroad grade crossings.

11. Designing underpasses with a head room less than 14 ft. in the clear.

12. Lack of co-operation on the part of public utility companies and municipalities. The highway departments should advise all interested utility companies and municipalities as soon as a highway project is decided upon, and these interested parties should immediately proceed to perform all necessary sub-surface work thereby eliminating delay in the progress of construction and the necessity for opening the pavement in the near future.

13. Absence of caution on the part of bonding companies. Bonding companies becoming surety for inexperienced persons who are operating under the guise of contractors or construction companies jeopardize the interest of the State engaged in highway construction. They should limit the surety to a fixed amount for the first contract, increasing the surety on the second contract, and so on until the applicant establishes his responsibility for carrying out contracts of magnitude.

14. The tendency of contractors to bid too low. This fault has had more to do with the performance of inferior work than any one other cause, and inexperienced contractors just entering highway construction are chiefly responsible, yet the bonding companies will go on their surety just the same as they will for experienced contractors.

15. Use of inferior material. Competition in manufacturing or producing material used in construction is such that inferior material is frequently put in competition with satisfactory material, and by under selling is used in the work. In many cases where inferior material has been rejected by engineers and officials they have been charged with favoring some particular material or product for reasons other than its merits.

16. It has been definitely determined that excessive use of water in mixing injures the quality of concrete, yet in many cases engineers, contractors and inspectors still permit the use of excess water. The contractor permits it because his force can turn out more work, and he claims it just as good. The inspector tries to remedy matters, but is unsuccessful. The chief engineer cannot see all the work, and a subordinate in carrying out his chief's desires is accused of retarding the progress of the work. However, anything that tends to add unnecessary cost to the construction and maintenance of the highway should be considered an abuse just as much as should a violation of the provisions set down to protect it.

All of these abuses should be corrected at once, and the industry protected by the soundest kind of financing, engineering design, faithful construction and efficient inspection.

Abuse of the highways after completion is generally caused by a small percentage of users. Such abuse frequently results in accidents, causing injury and loss of life and destruction of property. Law enforcement alone will not overcome these conditions or decrease the number of traffic accidents. The problem requires: first, adequate traffic planning, and second, proper enforcement of regulation according to the plan.

In order to enable those whose duty it may become to work out an equitable and uniform plan to prevent the abuse of the highways, the writer recommends:

1. That the minimum graded width of all main highways be not less than 30 ft. and (a) That this graded width be kept clear of all encroachments, and (b) That all traffic rules be made uniform.

2. That a system of marking one-way streets be adopted, which will be uniform as to type and location of the markers.

3. That it is desirable to standardize all directionary and cautionary signs as to color and marking, and that posting signs other than directionary and cautionary on the right of way be made unlawful, and subject to a fine for each offense.

4. That the erection of signs on property abutting on the highway at curves, railroad crossings and intersections be discontinued, where such signs would obstruct the view of those using the highway.

5. That it is desirable to standardize colors to be used for degree of danger where illuminated signs are used, for instance, red at a railroad crossing or dead ends of highways, green for highway intersections, and amber for grades and curves.

6. That a uniform traffic regulation be adopted for intersecting highways to be in effect in the absence of traffic officers.

7. That a uniform maximum height, width, and length of vehicle be adopted.

8. That a uniform gross weight of vehicle and load for each class of commercial motor vehicle be established.

9. That all gas filling stations be located on property abutting on the highways, and not on the right of way; and that all gas filling stations shall display a visible tag on each pump, which shall be placed there by the State Department of Weights and Measures certifying as to the accuracy of said measuring device.

10. That parking of vehicles on both sides of a highway opposite each other, where a minimum distance of 20 ft. between the vehicles is not provided, be considered a nuisance and be made punishable by a fine.

11. That the erection of all booths and stands for the sale of goods within the right of way, and displaying farm produce in containers within the right of way be prohibited, and that the use of vehicles for retailing wares along the highway where such practice would cause persons to congregate on the paved portion be also prohibited.

12. That a uniform penalty for operating a defective motor vehicle on the highway should be provided. It is not the purpose of this paper, nor is the writer qualified to discuss automobile design; however, there is a common defect particularly in trucks, the correction of which would eliminate one source of danger. Tail lamps frequently fail to function due to the wires having been damaged by abrasion or exposure to splashing water. It would seem to be an easy matter for the designer to provide protection for these wires. Other defects that the writer has in mind

are broken or improperly adjusted brakes and badly worn tires.

13. That legislation be enacted to provide against motorists running past barricades on roads under construction, and destroying unfinished work.

14. That sidewalks be provided for the use of pedestrians along the highway adjacent to built up communities.

15. That pedestrians using the highways in the open country shall walk to the left, and that operators of all vehicles drive to the right.

16. That when one piece shipments that exceed the maximum weight allowed by law are made, they shall be shipped on specially built vehicles so designed as to distribute the load in a manner consistent with legal requirements, and only after obtaining permission from an authorized source.

17. That a uniform distinction be made between maintenance, betterment and reconstruction in order that comparisons may be made.

18. That motor vehicle taxation or license fees should not be any greater than that required to provide the sum necessary for maintenance of the highways.

19. That overloaded trucks being operated on the highways, when apprehended, be seized and held for a period of not less than five days, stored at the owner's risk and expense, and in addition the owner fined, in accordance with a penalty fixed for that offense.

20. That hauling companies, who contract for shipments by the ton, when caught overloading their vehicles, should have their license revoked, in addition to any other penalty.

21. That all operators of motor vehicles should be licensed, and that they be prohibited from operating a vehicle for more than twelve consecutive hours followed by eight hours rest.

22. That, in addition to any uniform motor vehicle law previously recommended, all applicants for drivers' license or renewal of same be required to submit a physician's certificate bearing date not more than one month back of the date of application. Certificate should be accepted only from designated physicians, and should certify that the applicant is in fit mental and physical condition to operate a motor vehicle.

23. That the examination for drivers' license require the applicant to be able to read and write English, and that license be granted only to citizens of the United States with provisions for tourists from other countries.

24. That the owners of all motor vehicles must carry liability insurance for each vehicle operated.

25. That all vehicles both motor and horse drawn be equipped with a clearance light visible from front and rear. This light should be of a shape other than round located on the extreme left side of the vehicle or load if over width, and showing green in front and red in rear.

Long Railway Tunnel Opened in New Zealand

The 5¼-mile Otira tunnel on the New Zealand Government Rys. has been completed and the new line connecting the ports of Christchurch and Greymouth on the east and west coasts of the South Island will be in service early in 1923. Electric locomotives will operate the mountain division on which the tunnel is located. At present two railway lines of the Midland division terminate on opposite sides of Arthur's Pass and transfer of passengers and freight is effected by stages and wagons. The summit elevation of the pass is 3,050 ft. and of the tunnel 2,435 ft. The tunnel is on a continuous grade of 3 per cent. It is for a single-track line of 3½-ft. gage. In section it is 16 ft. 9 in. high above subgrade and 13 ft. wide at subgrade, with sides flaring outward to a width of 14 ft. 6 in. at the springing for the semicircular roof. Although in solid rock it is lined with concrete, the blocks for the arch lining being of precast concrete. A detailed description was given in *Engineering News* of May 9, 1912, p. 870.

Heat-Loss from Elevated Tanks in Winter

Heat-Loss Curves from Full-Size Tests—Coldest Water in Return Pipe Should Be Kept Above 35° F.

DATA on the heating capacity required to protect elevated steel sprinkler tanks from freezing have been developed by the Factory Mutual Laboratories, Boston, through full-size tests carried out between 1917 and 1922. The results, reported by C. D. Abbott, assistant engineer, are sufficiently precise and practical to permit of determining the total heat loss from an elevated tank in any climatic exposure, and selecting a heater of adequate capacity. In the following the principal results are summarized:

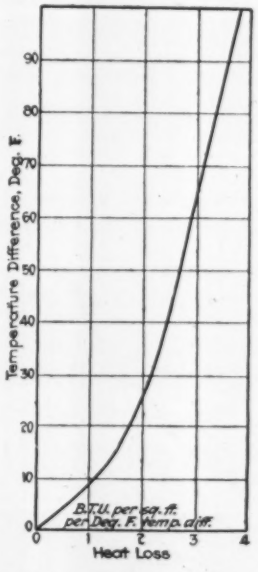


FIG. 1—UNIT HEAT LOSS, ELEVATED STEEL TANK

Loss per hour per sq.ft. water surface (including water in contact with steel) per 1 deg. F. difference between tank and outside air temperatures. Wind velocity at 12 mi. per hr.

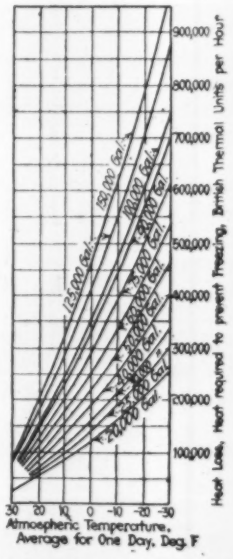

Heat Loss, Heat required to prevent freezing, British Thermal Units per Hour
Atmospheric Temperature, Average for One Day, Deg. F

FIG. 2—TOTAL HEAT LOSSES VARIOUS SIZED TANKS

Computed for temperature difference between minimum tank temperature and average air temperature ranging 30 deg. F. to —30 deg. F. Frost-proof cased steel tanks with hemispherical bottoms.

Two 50,000-gal. sprinkler tanks with hemispherical bottom furnished the principal test data. One, located on the roof of a factory, had a height of 155 ft. above ground (34 ft. above the roof), while the other was on an independent tower and was 75 ft. above ground. Both tanks were connected by piping to a heater consisting of a cast-iron shell within which was a brass steam coil. The heater drew cold water from the tank discharge pipe and discharged hot water at about the center of the tank; both the 2-in. hot water pipe and the 8-in. tank discharge were protected by a three-ply two-air-space wooden frost-proof casing. A steam trap in the steam return discharged the condensation into a barrel, emptying through a meter, so that readings of total condensation were obtained. Steam separator, pressure gages and thermometers in various parts of the water piping were provided to enable all necessary data to be obtained. Most of the actual runs were made while the heaters were operating, but some of them were made with steam shut off, in which case

the drop in temperature of the tank water measured the heat loss.

The results, reduced to hourly heat loss per square foot of tank surface for 1° F. difference in temperature between tank water and outside air are given by Fig. 1. The same data applied to tanks of various sizes and to various all-day temperatures of the outside air are represented in Fig. 2, from which the total heat loss of any tank in any location can be read directly. In the curves of Fig. 2 the tank water is taken to be at 45° F. average, corresponding to 35° F. in the coldest part of the circulating system, which is considered to be the minimum permissible temperature if freezing is to be avoided. The air temperature to be used in reading Fig. 2 is the all-day average temperature for the coldest day in the year at the place where the tank is situated; the temperature of this coldest day may be taken from the isothermals in Fig. 3, which are plotted from all available data recorded to May, 1922, for the eastern half of the United States.

Wind increases the heat loss, presumably by increasing evaporation and radiation. During the tests the wind velocity averaged about 12 miles per hour, and the curves in Figs. 1 and 2 are to be taken as applying to such wind. For higher wind velocities, the heat loss

FIG. 3—MINIMUM ONE-DAY AVERAGE TEMPERATURES

increases about 0.1 B.t.u. per square foot of *water* surface (top of tank) per degree temperature difference, for each mile per hour increase of wind velocity.

The warmest water in the system was found at the top of the tank, and the coldest in the return pipe close to the heater. At the latter point the temperature should not be allowed to drop below 35 deg., and generally a minimum of 40 deg. is advisable. The average temperature of water in the tank ranges from 10 to 15 deg. higher than that at the coldest point of the return pipe. However, water in the settling basin, at the bottom of the tank, is most sensitive to changes in amospheric temperature, and to prevent the freezing of water or sludge trapped here the top of the frost casing should be connected tightly to the tank bottom.

In selecting a heater for a tank, it should be chosen large enough to prevent freezing on the coldest day, even though water should be near the freezing point at the beginning of the low temperature period; it is always possible that by accident or otherwise the temperature of the tank may have dropped almost to the freezing point at the beginning of the coldest period.

The effect of scale, corrosion and sediment in restricting free circulation in the heating system should be taken account of in laying out the piping; the circulating system should everywhere pitch in the direction favoring circulation, and horizontal runs as well as water pockets should be avoided; and as the rate of heat transfer in the heater is found to increase with the steam pressure, the steam supply should be such as to maintain adequate pressure in the coldest weather.

Floor of Forth Bridge Reinforced

REINFORCEMENT of the floor structure of the Forth cantilever bridge was carried out between 1913 and 1920, following several previous repair and reinforcement operations. A description by W. A. Fraser before the Institution of Civil Engineers recently gave details of the work.

Reinforcement was necessary mainly because of deterioration of the floor troughs, which carry the timber rail sleepers, by fracture through the plates between rivet holes and by loosening of the rivets. Traffic weights increased from driving-wheel loads of 17 tons at the time the bridge was opened, in 1890, to 22 or 23 tons at present. Trouble was noticed as early as 1906, at the time the timber sleepers were renewed, when the bad condition of the troughs in which they rested and the loosening of horizontal rivets of the sub-floorbeams was seen. Local repairs were made at that time. Three years later additional sub-floorbeams were placed in the internal viaduct, which served to stiffen the rail troughs, but the deterioration of the troughs continued, so that by 1913 renewal of the troughs on the main bridge and the approach viaducts and strengthening of the sway frames were taken in hand, a contract being awarded to Sir William Arrol & Co. The contract covered also reinforcement of the main trusses of the approaches, by reinforcement of the subverticals, the addition of diaphragms between the flat plates forming the tension members, and additional sway bracing. The rail troughs and the buckle plates on the approaches and the internal viaduct of the main structure were renewed, and the sway frames of the internal viaduct strengthened. The new tail troughs are made of three 17-in. channels specially rolled for the purpose. Some extension of this work was ordered after completion of the first contract in 1917, and this was completed in 1920. The total reinforcement work involved 3,212 tons of new steel, replacing 2,400 tons of old steel removed. The work involved an expenditure of about $700,000.

Indiana Highway Bridge Construction

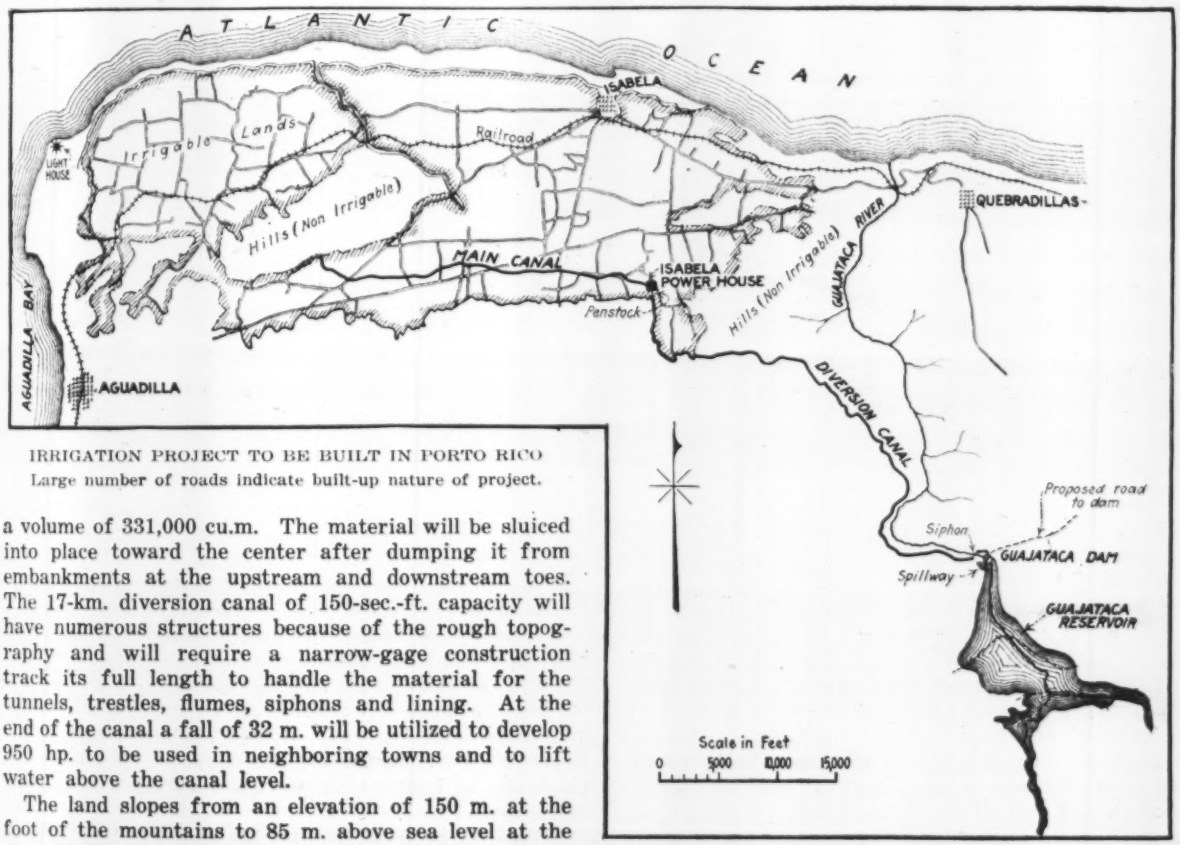
In three and one-half years since the organization of its highway commission, Indiana has constructed 148 bridges, at a total contract cost of $1,621,057.41. The total length of these bridges (some of the clear span length) is 2.52 miles. A little more than half of this bridge work was federal-aid construction. All the bridges are designed for 20-ton loads and have a minimum roadway width of 20 ft. Some have, in addition, 5-ft. sidewalks and a lighting system.

Porto Rican Irrigation Project Has Novel Features

Sinkholes in Reservoir Site to Be Sealed by Clay—Hauled-in Material for High Earth Dam to Be Sluiced to Place—Work Involves Expenditure of More than $3,000,000

By R. A. Gonzalez
Chief Engineer, Isabela Irrigation Service, Quebradillas, P. R.

More than three million dollars is to be spent shortly by the island of Porto Rico on the Isabela Irrigation Project which will irrigate 15,000 acres of land along the high rolling plain on the northwest coast. Despite the numerous sinkholes on the site of the storage reservoir required, geologists indicate that the project is feasible and the sinkholes can be sealed satisfactorily. Outlets of sinkholes in the flooded area were all found above the present river level. An earth dam, chosen because of the depth of the overburden, is to be built 37 m. high and 372 m. long on top. It will have a volume of 331,000 cu.m. The material will be sluiced into place toward the center after dumping it from embankments at the upstream and downstream toes. The 17-km. diversion canal of 150-sec.-ft. capacity will have numerous structures because of the rough topography and will require a narrow-gage construction track its full length to handle the material for the tunnels, trestles, flumes, siphons and lining. At the end of the canal a fall of 32 m. will be utilized to develop 950 hp. to be used in neighboring towns and to lift water above the canal level.



IRRIGATION PROJECT TO BE BUILT IN PORTO RICO
Large number of roads indicate built-up nature of project.

The land slopes from an elevation of 150 m. at the foot of the mountains to 85 m. above sea level at the steep bluff which follows the coast line around this part of the island.

One-third of the total area of the project is in small holdings of less than 20 acres. Another third is in holdings of more than 100 acres. The principal crops are sugar cane, tobacco, corn, beans, onions, sweet potatoes, fruits and cotton. Sugar cane will probably be the principal crop after irrigation is established.

Water for the project will be stored in a reservoir of 28,000 acre-ft. capacity to be constructed on the Guajataca River at a point about 10 km. south of Quebradillas. The dam will flood a flat valley of 923 acres above the Quajataca Canyon.

Duty of Water and Water Supply—The lowest annual rainfall recorded in the irrigable district is 37 in. and the mean 54 in. It is believed that 70 per cent of it will be beneficial, resulting in a minimum of 26 in. and an average of 38 in. of beneficial rainfall. Sugar cane requires at least 72 in. of beneficial water per year. The duty of water has been taken at 4 acre-ft. per year delivered at the land, which will insure a good supply of water in the driest years.

Records of flow of the Guajataca River near the dam site have been kept for the last six years. Rainfall records at Lares, a town located near the center of the drainage area, are available since 1903, and indicate an average rainfall of 97 in. per annum. The fact that rainfall and run-off records have been kept over the same period of several years has been used to determine the percentage of run-off for this period. The percentage relation between run-off and rainfall was estimated at 60 per cent for the dry months from January to May inclusive, and 86 per cent for the remaining months. These percentages have been used to estimate the run-off for the whole period of years for which rainfall records are available. Although subject to considerable error, this is believed to be as close a determination of the run-off as can be made with the data available.

The drainage area above the reservoir embraces about 25 sq. miles of mountainous country. The comparatively high percentage of run-off (average about 75 per cent) indicates that there may be an additional drainage area contributing to the flow of the Guajataca River through sinkholes and underground drainage found in the limestone formation, characteristic of this region.

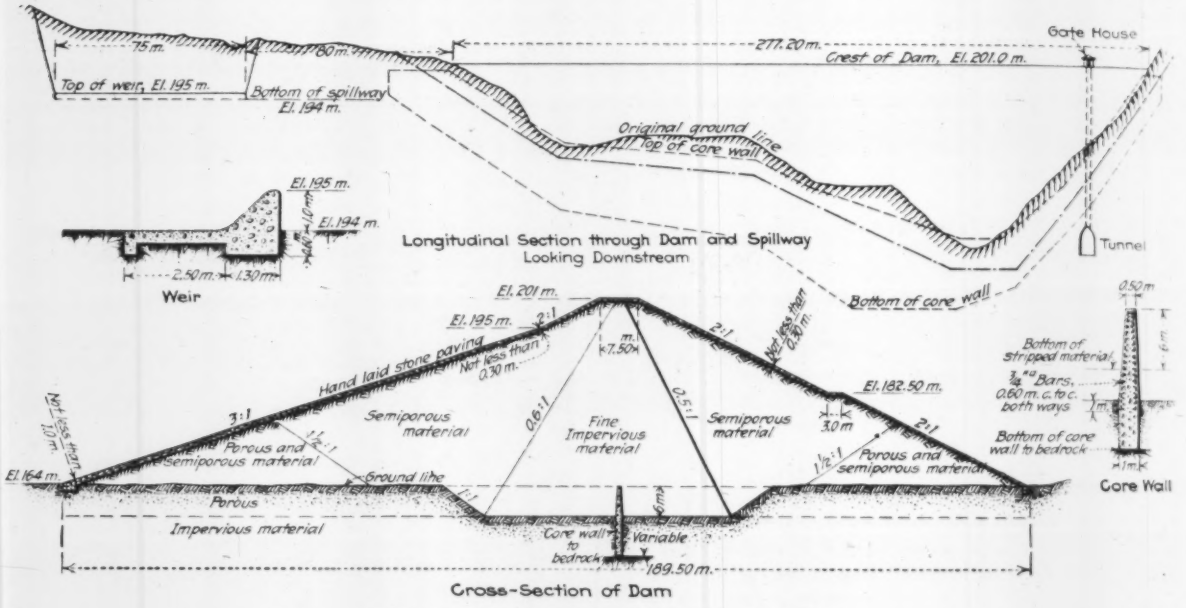
Geology of Dam and Reservoir Sites—Since the limestone formation and the presence of a well developed sinkhole country immediately north of the reservoir site caused considerable apprehension as to the suitability of the site for a reservoir, the services of a geologist, G. R. Mansfield of the U. S. Geological Survey, were obtained to study the geological conditions and to report on the probabilities of excessive seepage losses. Mr. Mansfield concluded that the project is feasible.

The country immediately north of the site is occupied by a broad belt of sharp featured limestone hills that rise approximately 1,000 ft. above sea level. Intervening depressions several hundred feet in depth, ranging in diameter from a few hundred feet to half a mile or more are bounded by steep slopes. These depressions are sinkholes developed to an unusual degree. Through this region the Guajataca River has cut a deep canyon. South of this hill belt is a more open country, where stream valleys are the features instead of sinkholes, though these depressions are also present. The reservoir site is in this belt of more gently sloping country. South of this belt there is another belt of rough limestone hills running east and west.

The limestone in which the reservoir site is located is softer than that in which the big sinkholes farther north are found, and contains a relatively high per cent of clay. The soil produced by the disintegration of this limestone is very stiff and clayey and 2 or 3 ft. thick over most of the reservoir site. Below this layer is a zone in which lumps of limestone are found in a clayey matrix, the matrix becoming less and less conspicuous with depth. The lower part of this zone grades into the unaltered bedrock. Bedrock is found at the dam site at a depth of about 12 m. except toward the middle where it is as much as 25 meters.

Some 80 sinkholes have been found within the area to be flooded, ranging in diameter from about 30 cm. to a maximum of 5 m. They have all been tested by pouring in water colored with analine and found to have outlets above the present river level.

The conditions considered favorable for the development of a reservoir at this site are summarized as follows: (1) The clay content of the rock tends to make it self-sealing. (2) The heavy clay soil derived from the decomposition of the limestone clogs the pores and cracks of the underlying rock and forms a thick cover that protects it from surface waters. (3) The open sink-holes are all comparatively small and can readily be filled and sealed. All of those thus far recognized have outlets above the present level. (4) Cracks in the exposed rock surfaces are comparatively few and can also be sealed. (5) The high percentage of run-off indicates that there is comparatively little loss of water by underground drainage. (6) The rapidity with which the river rises in response to heavy rains indicates that its basin is relatively watertight and that it sheds water easily.



SECTIONS OF GUAJATACA DAM AND SPILLWAY

The foundation conditions are being thoroughly investigated by means of diamond drill borings and test pits. These investigations are well advanced. Bedrock at the dam site consists of relatively soft, grayish-white limestone, interbedded with layers of stiff clay. It is found at depths of from 12 to 25 m. below the surface. The overburden consists largely of clay intermixed with lumps of limestone and of occasional strata of pure clay. A stratum of relatively hard but broken limestone from 3 to 6 m. thick lies immediately above the grayish limestone described as bedrock. The drill holes show a bed

of fine sand which is considered to be a pocket rather than a continuous stratum.

Method of Building Dam—The central portion of the embankment is to consist of a puddle core founded on impervious material and a concrete corewall will be provided to cut off any percolation between the foundation material and puddle core. The bottom of the corewall will be founded on impervious bedrock well below any sand layer and will extend upward into the puddle core a distance varying from 6 m. at the maximum section to 3 m. at the ends of the embankment.

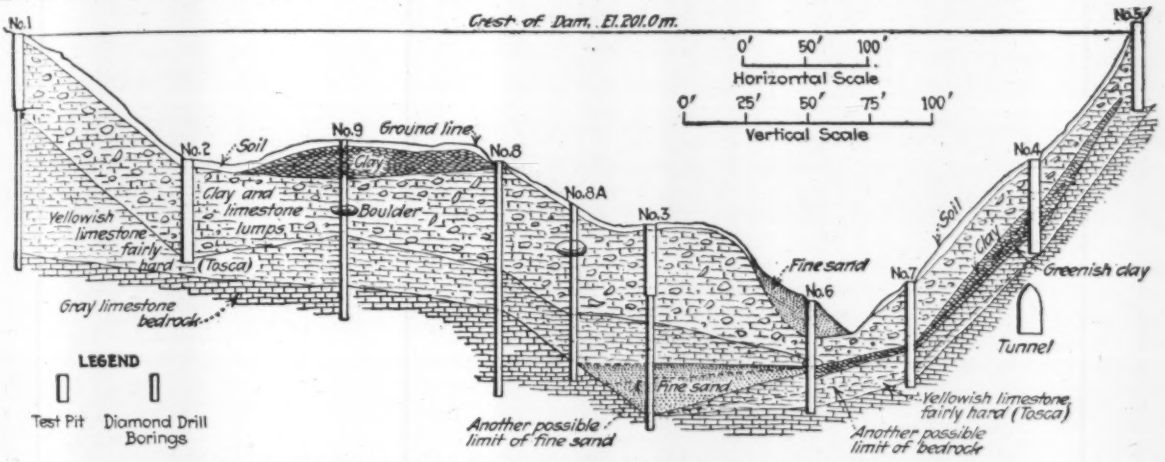
The section of embankment has been designed to facilitate the grading and compacting of materials by hydraulic methods. The embankment materials are to be loaded by steam shovels into dump carts which will be hauled from the borrow pits to the embankment by steam dinkeys. The track will be maintained along the outer slopes of the embankment where all materials will be dumped. No trestles are to be used as it is believed the required sluicing grade and the method of jetting will give sufficient elevation from which to dump the cars. After dumping the embankment material along the two outer slopes, it will be sluiced into place by hydraulic giants. This method of distributing the materials will effect very thorough compacting and uniform grading from the finest material in the puddle core to the coarsest material in the outer slopes.

The material available for the embankment consists of clay intermixed with lumps of limestone found near the dam site. Material excavated from the spillway channel will also be used. The percentages of clay vary from 30 to 60 per cent. Material will be selected from the borrow pits so as to keep the amount of clay between 30 and 45 per cent.

A tunnel 6 m. square will be provided in the right abutment for diverting the river during construction. The material excavated from the tunnel and portal cuts will be deposited in the outer toes of the embankment to serve as cofferdams for diverting the river and for unwatering the puddle core and corewall trenches.

The diversion tunnel will be utilized after completion of the dam as an outlet to the canal. It will be plugged by a concrete bulkhead wall near the inlet, and immediately downstream from it a concrete octagonal gate tower will be built over the tunnel. Two sluice gates will be provided at the base of the tower and a third one at the same level as the canal intake, which is 16 ft. above the base of the tower. The tunnel will also be plugged near its outlet with a bulkhead wall provided with a sluice gate. Immediately upstream from this bulkhead a vertical uptake shaft will connect the tunnel to the diversion canal.

At the left end of the embankment will be provided a spillway channel controlled by a low concrete weir 75 m. long. The spillway is designed for a maximum run-off of 1,100 sec.-ft. per square mile of drainage area, at which rate the maximum depth of water that will pass over the spillway is estimated at 3.75 m. The freeboard of embankment will be then 2.25 m. The spillway channel will be left unlined, although on account of the soft nature of the rock, it seems probable that ultimately it will have to be lined.



RESULTS OF TEST PIT AND DIAMOND DRILL EXPLORATIONS AT DAM SITE

Diversion Canal—Types of construction in the diversion canal include the following:

Unlined canal	8,000 m.
Lined canal	1,000 m.
Bench flume	2,100 m.
Tunnel (24 in number)	2,260 m.
Trestle flume	367 m.
Siphon	251 m.

The construction of the canal will be rendered difficult by the inaccessibility of portions of it, and by the fact that water will have to be transported considerable distances. In order that material may be transported along the canal it will be necessary to excavate first a bench along the same on which a narrow-gage track may be laid, and to open most of the tunnels so that the track may be laid through them. Concrete aggregate will be made along the canal as required by a portable rock-crushing and sand-making plant. Concrete work will be started from the center of the inaccessible section toward both ends removing the track as sections of the canal are completed.

The canal will be of 150-sec.-ft. capacity, and the slopes will be 0.0006 for canal and bench flume and 0.002 for tunnel, siphon and trestle flume. In fixing upon the initial grade and canal slopes the additional cost of a higher dam has been balanced against the value of the additional irrigable area and power development obtained.

Distribution System—The project lands consist largely of uneven, rolling country with many isolated hills and depressions or potholes through which the surface waters drain. However, there are some comparatively large areas of fairly uniform land. Topographic surveys have recently been made by the U. S.

Geological Survey of about 32,000 acres, half of which has been classified as good irrigable land. Due to the uneven nature of the ground the distribution system will require a large amount of canal lining, flume, siphon and also a large number of drops, culverts, turnouts and measuring structures. In this connection careful consideration is being given to the use of precast concrete for these structures.

It is proposed to do all work by administration forces. The project, which is estimated to cost about $3,325,000, will be financed and constructed by the Government of Porto Rico. Construction work will not be started until the final designs and reports have been approved by the Legislature of Porto Rico.

A board of engineers from the U. S. Reclamation Service composed of F. E. Weymouth and J. L. Savage, recently visited the site of the proposed irrigation works. After a thorough examination of the plans and reports concerning the project, they submitted a report to the Governor of Porto Rico favorable to the construction of the project.

Accidents Decreased at Street Crossing Where Traffic Circle Was Used

A METHOD of passing vehicular traffic constantly and without a traffic officer was tried for some months at the intersection of Wilshire Boulevard and Western Ave. in Los Angeles and was described in *Engineering News-Record*, Sept. 28, 1922, p. 520. Some complaint was made as to this method of handling traffic and the City Council ordered the circle removed. When workmen began to tear it out there was such immediate and vigorous opposition that the order for removal was promptly withdrawn. By the time the order could be put into effect, however, the work of destruction was almost complete. What the city's future policy will be with regard to traffic circles has not yet been stated.

Meantime the accident statistics for this crossing taken from police reports show that not only did the circle reduce the number of accidents by one-half, but the seriousness of the accidents as indicated by the estimated amount of property damage was reduced in still greater proportion. The records of accidents at this intersection and at another intersection in the vicinity which handled approximately the same traffic are given in the accompanying table.

BEFORE THE INSTALLATION OF SAFETY CIRCLE AT WILSHIRE BLVD. AND WESTERN AVE.

	Wilshire and Western		Wilshire and Vermont	
Month, 1922	Number of Accidents	Estimated Cost of Property Damage	Number of Accidents	Estimated Cost of Property Damage
January	14	$415.00	9	$295.50
February	10	400.50	10	440.50
March	16	471.75	7	80.00
April	10	204.00	4	17.00
Totals	50	$1,491.25	30	$833.00

AFTER THE INSTALLATION OF SAFETY CIRCLE AT WILSHIRE BLVD. AND WESTERN AVE.

	Wilshire and Western		Wilshire and Vermont	
Month, 1922	Number of Accidents	Estimated Cost of Property Damage	Number of Accidents	Estimated Cost of Property Damage
May	3	$16.70	15	$336.40
June	8	98.90	7	209.00
July	12	157.20	10	298.80
August	2	6.50	10	351.75
September	4	37.15	13	286.50
October 1-17	3	37.00	7	158.00
Totals	32	$353.45	62	$1,640.45

Rail Reclamation Practice on the Illinois Central R. R.

Rails with Worn Ends Are Sawed and Drilled at Portable and Fixed Plants and then Relaid—Force and Output

SINCE the wear of rails often progresses more rapidly at the ends, necessitating renewal although the main part of the rail may be in good condition, it is frequently economical to cut off the damaged ends and thus reclaim rails good for relaying. Two plants for cropping and drilling rails which are worn or battered at the ends are operated by the Illinois Central R.R. One of these is a permanent plant at Centralia, Ill., and the other is a portable plant which is shifted to various distant points where worn rails are assembled. This portable plant therefore avoids a long haul of the rails to and from the permanent plant when the rails are to be relaid in the same district from which they have been removed, or in an adjacent district, when these districts are at a considerable distance from the permanent plant. Practically all the reclaimed rails are used in main track on the less important lines of the system.

FIG. 1—RAIL RECLAMATION PLANT IN OPERATION

Worn rails from stack at the left are being sawed and drilled on the portable plant and loaded into cars for shipment.

Originally the rails were sawed to reclaim the maximum length from each rail, but this caused inconvenience due to the great variety of lengths. It was therefore decided to make a uniform crop of either 12 or 18 in. at each end, according to the length of splice that had been used. Thus worn 33- and 30-ft. rails give standard reclaimed rails 31 or 30 ft. and 28 or 27 ft. long respectively. The rails to be sawed are selected usually by the supervisor of the district on which the rails are removed. The weight of rails thus reclaimed ranges from 75 to 100 lb. per yard. It has not been necessary to caliper the heights of the rail ends in order to insure proper matching at the joints, owing to the fact that the rails taken out of track are usually loaded directly onto cars and the rails on each car are put through the machine as soon as they arrive. In this way the rails of each lot, with practically uni-

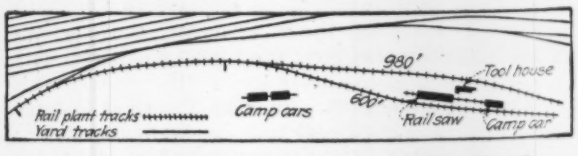


FIG. 2—LAYOUT OF RAIL RECLAMATION PLANT

FIG. 3—PORTABLE RAIL SAWING AND DRILLING MACHINE

form wear, are kept together and do not get mixed with rails which come from other locations and might have a different amount of wear.

Portable Plant—The main feature of this plant is the rail-sawing car, 61 ft. long, shown in Fig. 3. A view of the plant in operation is given in Fig. 1, and the general layout is shown in Fig. 2. On the heavy steel underframe of the car are mounted a boiler, horizontal engine, 44-in. water-cooled disk saw running at 1,980 r.p.m., roller feed tables and two rail drills. A pneumatic hoist handles the rails to and from the tables, where they are secured by pneumatic clamps. Driven rollers in the feed tables provide for moving the rails easily. An air-brake pump with receiver 36 x 72 in. furnishes compressed air for the hoist, clamps and tables.

For drilling bolt holes for the new splices there are two double three-spindle drills operated from a countershaft driven by the engine. When the machine was purchased the railroad was using six-bolt splices, so that three-spindle drills were required, but the present practice is to use four-bolt splices, the drills being adjusted accordingly. In Fig. 1, the worn rails are stacked at the left and a derrick car is loading the reclaimed rails into a gondola car. During transportation and when not in use the sides of the car body or housing are lowered to enclose the machinery. This rail sawing machine was built by the Industrial Works, Bay City, Mich.

When running at full capacity there is a force of 21 men, as follows: Engineman, fireman, saw man, two drill men, two men loading and unloading rails, one helper, one handling the hoist, two chipping and oiling rails and straightening rails on the cars, eight men handling rails on feed table to saw and drills, one tool dresser helper and one man handling coal and cinders. About 6,000 ft. of rail can be sawed and drilled in an average 8-hour day.

Permanent Plant—The layout of the rail sawing plant in connection with the general reclamation plant at Centralia is shown in Fig. 4. The equipment includes a circular saw, shear, forge, rail bender, drill press, two rail drills and a saw grinder, with the necessary equipment of skids and roller tables. The machinery is driven by electric motors. A force of 22 men is employed, as follows: Foreman, saw man, air-hoist man, two drill men, four drill helpers, one marker (painting ends of rails to indicate length), five laborers unloading rails, four laborers loading reclaimed rails, one man feeding rails to saw, two men pulling the rails away from the saw. The average output of this plant is 10,000 ft. of rail drilled and sawed per 8-hour day.

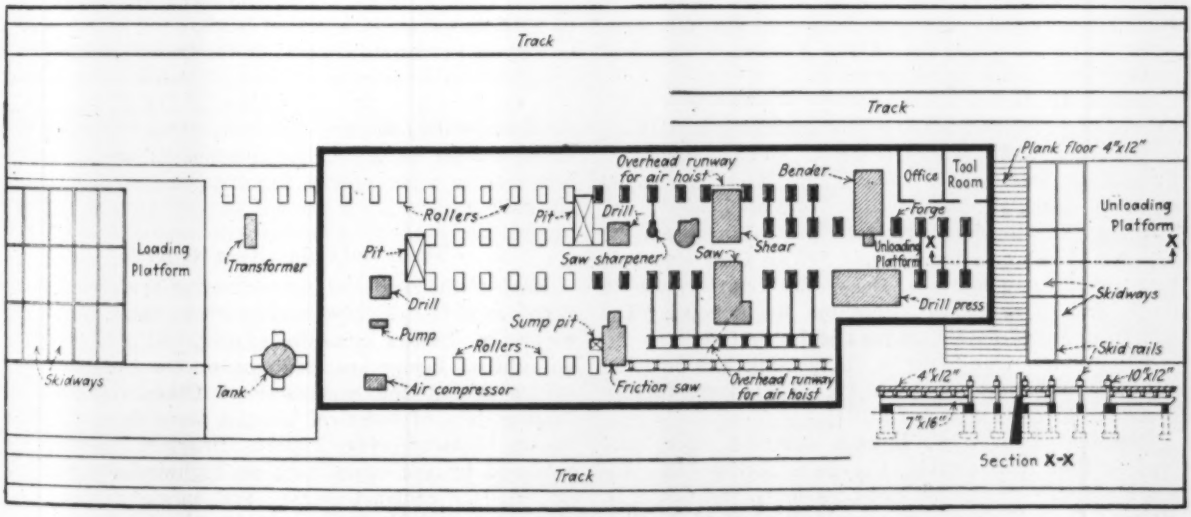


FIG. 4—PERMANENT RAIL RECLAMATION PLANT AT CENTRALIA

Annual Meeting of American Society of Civil Engineers

Vigorous Activity and Interest Displayed — Technical Sections Organized and Additional Research Work Initiated—Sessions on Education, Research and Town Planning—Loweth President

AN ATTENDANCE of more than 1,200 and a most active technical interest distinguished the seventieth annual meeting of the American Society of Civil Engineers, held at New York last week, covering the three days of Jan. 17 to 19. An important development of the society's work was initiated by the organization of four technical divisions of the society, through which intensive cultivation of separate fields of civil engineering is to be made possible by specialization. Another development was the extension of the action taken within the past two years toward encouraging research; two additional special research committees were created, one to deal with reinforced-concrete arches, the other with the strength of steel columns.

Three technical sessions were held during the meeting, and several technical committees presented reports of results, among them the committee on stresses in railroad track. Almost for the first time in the history of the society, administrative business took a quite subordinate position.

Ceremonies in connection with the bestowal of honorary membership upon five distinguished engineers, American and European, and the award of medals and prizes for papers contributed to the society, gave the opening session of the meeting a most impressive character. The new honorary members are Leon Jean Chagnaud, of Paris, constructor of the Loetschberg tunnel and of the Rove Canal tunnel; Sir Maurice Fitzmaurice, of London, long engineer to the London County Council; Prof. William C. Unwin, of London, distinguished educator and engineering authority; Clemens Herschel, of New York, past president of the society, hydraulic engineer; and John F. Stevens, of New York, railroad engineer, whose vitally important work in the construction of the Panama Canal was emphasized in the presentation.

Charles H. Paul was awarded the Norman medal for his paper on "Core Studies in the Hydraulic-Fill Dams of the Miami Conservancy District." The J. James R. Croes prize was awarded to William Cain for a paper on "The Circular Arch Under Normal Loads"; the Thomas Fitch Rowland prize to Gustav Lindenthal for a paper "The Continuous Truss Bridge Over the Ohio River at Sciotoville"; and the James Laurie prize to A. T. Safford and E. P. Hamilton for a paper "The American Mixed-Flow Turbine and Its Setting."

The business transacted at the meeting was noted in our news columns last week (p. 132); some further items are given this week (p. 181).

President Charles F. Loweth assumed office, succeeding John R. Freeman. George S. Davison and Anson Marston were elected vice-presidents, and Glenn D. Holmes, E. B. Whitman, George H. Fenkell, T. L. Condron, R. N. Begien, and George C. Mason were elected directors.

On Thursday about 650 members and their guests journeyed by special train to Bethlehem, Pa., where they inspected the Hill-to-Hill Bridge, now under construction. After luncheon at the Bethlehem Hotel as guests of the Bethlehem Steel Co., the party divided, one group going to inspect the John Fritz Laboratory of Lehigh University while the other was taken on a trip through the Saucon and Lehigh plants of the steel company. The lining for the Hudson River vehicle tunnel is being manufactured at the latter place and a section had been erected on the ground to show the cross-sectional dimensions and arrangement of the tunnel. A ring of the lining used in the first of the Hudson tubes was assembled also alongside the vehicle tunnel exhibit and illustrated in striking fashion the great size of the new tube.

On Thursday evening the society was addressed by Julius H. Barnes, president of the Chamber of Commerce of the United States, on the subject "Transportation Keyed to Production." Mr. Barnes based his remarks on the proposition that an advancing standard of living demands a production in excess of current consumption, that this production must be served by adequate distribution, and that in the processes of distribution, adequate transportation is the prime requisite.

After sketching the extraordinary growth in our productive capacity and in our volume of production he turned to a consideration of our transportation facilities which must provide for the distribution of these goods and pointed out that while economies in operation are continually making possible a greater volume of transportation for the capital invested in the plant, it is manifest that any material expansion of service must require large additional capital investments. The estimate made in 1907 by James J. Hill that the roads would have to invest 1,100 million dollars per year for five years to equip adequately the terminals of the country has been vitiated, in Mr. Barnes' opinion, by the supplementary service rendered by a new form of transportation—the motor truck.

But the proper adjustment of the transportation burden between the several agencies of railroads, highways and waterways is now a problem of the foremost importance, which, declared Mr. Barnes, must be painstakingly studied before large investments are made in terminal or other special facilities and equipment on the railroads.

Technical Committee Reports

Most of the technical committees of the society rendered reports. Notable among these were the third report on stresses in railroad track, and a final report on railroad bridge specifications by the committee on bridge design and construction. Other reports containing data of technical interest were those on soils and on highway bridge impact. Progress reports were rendered by the committees on highway engineering, on standard contract clauses, and on electrification of steam railroads, the latter committee having begun work only within the past year.

Track Stresses—Following on the investigations reported in 1918 and 1920, namely a general investigation of roadbed depression and stresses in the rails, and experimental study of the effect of locomotive counterbalance and the stresses in ties and ballast, the committee entered upon a study of curved track, which continued during the past three years. It finally re-

ported on this subject at the present meeting. Careful comparative tests on straight and curved track under otherwise identical or similar conditions were carried on, of such remarkable thoroughness as to include, for example, 470,000 individual stress readings from autographic smoked-disk records taken under moving locomotives. The results show very high lateral bending stresses in the rails, both inner and outer, varying through a large range as the speed is increased, and also large lateral movement of the rails (distortion of track) as the locomotive moves over it. The phenomena of curve action of railway vehicles are more fully explored by these tests than by any prior investigations. Much light is thrown also on the decisive relation of locomotive design to the safety of track. As the report is voluminous, covering 162 pages with 102 diagrams and other illustrations, fuller indication of its contents must be reserved for another occasion.

Bridge Specifications—A specification for railway bridges submitted by the committee on bridge design and construction a year ago was exhaustively discussed and much criticised before the society during the year. In consequence the committee prepared what is virtually a new specification, differing from other current specifications in being much shorter and restricting itself to the more general considerations, so as to leave various detail requirements to the individual engineer. The specifications are intended to apply to spans of any length. The recently proposed M-system of engine loading, proposed by D. B. Steinman, is specified as an alternative to the E-system of Theodore Cooper. The old impact formula is retained. A column formula of the Rankine type is specified. The basic working stress specified is 16,000 lb. per square inch, but with the proviso that the design shall also take into account a live-load 50 per cent greater than that for which the bridge is designed, with 50 per cent increase in unit stress (thus giving a 24,000-lb. eventual base).

The committee expects to present a highway bridge specification in the course of the current year.

Foundation Soils—One of the main divisions of the work of the committee on bearing power of foundation soils, namely, a codification of existing practice with respect to allowable bearing power, was finally reported upon in this year's progress report. The committee finds that conditions are so variable, especially with respect to the identification of soils, that it is not practicable to prepare a codification of practice. In its study of soil constitution, however, the committee has progressed to the definite isolation of the colloidal constituent in clay, a sample of which was exhibited at the meeting. A review of recent literature on soil constitution also formed part of the report. Work of direct practical application is contemplated for the immediate future.

Highway Bridge Impact—One of the research committees of the society appointed only a few months ago, on impact in highway bridges, presented a summary of extensive tests of impact in a 150-ft. steel truss highway bridge with concrete floor, carried out in Iowa during the past summer. Very high impacts in some members of the trusses, and quite generally in the floor members, were found when trucks were run over slight obstructions placed on the floor. The highest results were found with a caterpillar tractor, in which case some impacts of 100 per cent even with unobstructed floor were observed.

Research Session

In recognition of the increasingly important position of civil engineering research in the work of the society, a separate session of the meeting was devoted to this subject. Four papers were presented. One of these, "Radio and Research," by O. B. Blackwell, dealt with a subject foreign to normal civil enginering but was of great interest and stimulative value.

Arthur N. Talbot, past president, and chairman of the society's committee on research, discussed the society's research activities at some length. Setting forth the basic reasons for including research in the society's normal functions—the fact that engineering science depends for its growth upon the conscious searching for new knowledge, and the fact that the society through its command of the field is in a favorable position to recognize needs and map out a program for investigative work—he pointed out that past work of the society in this field has been limited to discussing and publishing papers setting forth engineering knowledge, and has included no direct stimulation of research. Since the inauguration of a more aggressive policy a little over a year ago, distinct progress has been made. Research has been inaugurated in five subjects: working stresses for steel structures, flood protection data, irrigation engineering, hydraulic phenomena, and impact in highway bridges; and work is about to begin on the subjects of reinforced-concrete arches and steel columns. He pointed out, however, that there are very many problems awaiting investigation, and that it will be vital to the best success of the work to select wisely those problems which are most urgent. Much of the work will be of a kind that has value to many practical and commercial interests, who may be expected to support it, but Prof. Talbot emphasized the fact that the society has a specific duty toward subjects which are not likely to appeal to outside contributors.

Engineering Foundation—A concise review of the development of the two organizations known as Engineering Foundation and Division of Engineering of the National Research Council was presented by Alfred D. Flinn, director of the Engineering Foundation. He stated that this organization is "an integral part of the organism of the founder societies and of each one individually, just as the Library is," and that it is "their joint instrumentality for research and investigation, especially for such projects as involve more than one branch of engineering and science." The paper also contains a list of the investigations now under way in charge of the Division of Engineering of the National Research Council, including the following subjects: Deoxidizers, electrical core losses, electrical insulation, fatigue of metals, hardness testing of materials, heat treatment of carbon steel, marine piling investigations, molding sand, Neumann bands, physical changes in iron and steel below the thermal critical range, pulverizing, and uses of tellurium and selenium. Two other investigations, on heat transmission and on illumination, are not yet organized. Engineering Foundation, on the other hand, has supported an investigation of hollow-crested weirs, and has organized a study of arch dams and a study of wood-finishing processes. It expects to participate in a study of reinforced-concrete arches in co-operation with the research committee of the American Society of Civil Engineers. A study of the technical features of the boll weevil campaign is under advisement.

New Views On Steel—Under the title "The Study of Steels for Engineering Structures," Dr. George K. Burgess, of the U. S. Bureau of Standards, reviewed the present status and probable future of steel as a structural material in rather broad perspective. Describing the present as a stage intermediate between the low-carbon steel and the alloy steel periods, he suggested the possibilities that may be found to lie in the use of aluminum and duralumin; the former is credited with a structural efficiency (strength divided by weight) only one-tenth lower than that of structural (mild) steel, while the efficiency of duralumin is three times that of aluminum and one-fifth greater than that of heat-treated alloy steel. He referred at some length to the steady tendency toward the use of higher-strength steels, and discussed both nickel-steel and copper-manganese steel (the latter in decidedly encouraging terms), as well as silico-manganese steel. There does not appear to be much room for improving the quality of structural metal by cleaner furnace practice, however important this may be in high-carbon and alloy grades. Heat treatment, on the other hand, is a distinct possibility; it is already used for eyebars and may be applicable to built members.

Dr. Burgess then outlined some of the Bureau of Standards work, and described two new test devices. One is a remote-reading extensometer based on the principle that the resistance of a carbon contact varies with pressure; the instrument has been brought to thoroughly practical form and has been used in some important recent tests. The other device is a process for making strain lines (Lüder lines) readily visible on a steel surface, and consists of coating the strained surface with a white cement wash.

City Planning Session

A whole session was given up to city planning at which three papers were presented and discussed. The larger part of the paper on "Regional Planning," by Nelson P. Lewis, now director of the physical survey for the plan of New York and its environs being made under the auspices of the Russell Sage Foundation, was devoted to an outline of that work. The area under study includes 5,500 square miles located in three states and has a combined population (1920) of about 9,000,000. In this area there are nearly 400 different political units. The metropolitan division of the area, which includes all of New York City, together with Hudson County and Newark, N. J., has an area of 360 miles and has a population of 6,700,000. What is called the suburban division has an area of 1,170 square miles and a population of 1,360,000. The remainder of the region, classed as rural, has an area of 3,970 square miles and a population of 940,000. It is estimated that by 1960 the population in the entire region will be 20,000,000 and that in the year 2,000 it will be 37,000,000, the latter divided into metropolitan, 20,000,000; suburban, 13,000,000; rural, 4,000,000. The survey now in progress is a determination of the regional planning problem that needs solution.

Zoning and Planning—The general principles and practice of zoning were outlined by Morris Knowles, consulting engineer and chairman of the city planning commission of Pittsburgh. Zoning promotes municipal economy, facilitates city planning, simplifies traffic control, and makes for better health and sanitation. It is important that competent legal advice should be had in connection with zoning, since there are many snags to be avoided. A zoning consultant from outside the city is desirable. Publicity work cannot be overdone if the public support needed for the adoption of a zoning plan is to be secured. All zoning plans must show a fair relationship between public good and the reaction upon individual property owners.

In a paper entitled "The Engineer and City Planning" George H. Norton, city engineer and chairman of the city planning commission of Buffalo, N. Y., said that the "ills of the municipal body lie in its deformed and unguided growth rather than in its charter or ordinances" and added that the "beautification" of the city "should be in ordered arrangement and growth more than in surface embellishments." The city planning engineer has a threefold problem: (1) His plan must "appeal to the sound judgment of a large part of the citizens"; (2) he must co-operate with "the ever present public spirited citizens who are ready to assist in laying the matter fully before the whole electorate in such manner as to win their approval"; (3) when such public approval has been secured that of the city authorities must be obtained. Beyond this, the city planning engineer must always consider the human element. In conclusion Mr. Norton said:

> No other field today offers a fairer range for the highest development of engineering perspective or the formulation of new standards, and certainly none promises a fuller opportunity for the engineer to take his place as a leader of public thought, qualified to guide the development of our greatest institutions, the cities.

Discussion—The three papers were discussed together. C. W. Leavitt urged that in regional planning work one of the main objects should be decentralization, a distribution of population and industry so that as many as possible of the people may get to their work by walking. He also urged that real-estate developments be not permitted to block regional arterial routes. Frederic Delano, a member of the committee on the plan of New York and its environs and a former member of the Chicago city planning commission, said that city planning activities in Chicago were begun twenty years ago. No one man could ever make a city plan that would be adopted or if adopted that would be carried out.

E. A. Fisher, consulting city engineer and superintendent of city planning at Rochester, N. Y., said that the Rochester city planning bureau, which has been in existence for some five years, is a part of the department of engineering, where he believes such a bureau belongs because the bureau gets the benefit of the city engineer force, and the latter keeps in touch with what the bureau is doing. About four years ago the city was zoned as to use, but not as to area and height. Recently height and area regulations have been drafted.

Education Session

The session of Wednesday afternoon was held jointly with the Society for the Promotion of Engineering Education and was addressed by Prof. Charles F. Scott, president of the latter organization, Prof. William G. Raymond, dean, College of Applied Science, State University of Iowa, Magnus W. Alexander, managing director National Industrial Conference Board, and John L. Harrington, president Am. Soc. M. E.

Professor Scott outlined the new project of the Society for the Promotion of Engineering Education, whereby it is to conduct through its newly-appointed Board of Investigation and Co-ordination an intensive study of the needs of engineering education with respect

not only to the conditions in the schools themselves but also to the requirements of industry. An abstract of the report upon which this project is based was given in *Engineering News-Record* of Sept. 28, 1922, p. 537.

The full functioning of the board, he declared, must await the securing of funds and the selection and appointment of a director and staff.

Dean Raymond reviewed the status of engineering education in the schools of the middle West, taking as the basis of his conclusions the information gleaned from a questionnaire which was answered by two foundation schools and twelve publicly supported schools in that regions. Although it was expected that because of the hard times that have come to the farmers during the post-war period there would be a falling off in college attendance in the Midwest this prediction has proved to be unwarranted.

The immediate outlook, Dean Raymond considers, is for smaller attendance, which, due to present overcrowded conditions, will not be displeasing to the officers of the schools. He suggests that it will be some time before the schools get on a really efficient basis unless the combined effect of some additions to staff, space, and equipment and a considerable reduction in attendance brings about a condition of balance. He referred also to the poor preparation of the graduates of secondary schools in the midwest territory although he could not say whether this poor preparation is peculiar to that region. There is a tendency, he declared, to make the secondary schools practical schools, training most of their students for business life rather than for college entrance. He notes also a distinct tendency away from those things that appear to be difficult—such as examinations to test the student's knowledge.

In discussing engineering research, Dean Raymond took issue with those who have held it to be the primary function of a university. On this subject he spoke as follows:

> There are those who do not hesitate to say that the primary function of a university is research; that its teaching work is incidental. It is believed that except with respect to those institutions created primarily for research, such a statement is wide of the fact, and certainly with respect to the state universities of the western and southern states it is not in accordance with the ideas in the minds of those who created these institutions.
>
> The state universities, standing as the capstones of the educational systems of the states, were created primarily to give what was commonly known as a college education to the youth of the states. The idea of research was hardly thought of by any one connected with the institutions when they were created. This idea in connection with these institutions is of modern growth.
>
> There can be no quarrel with the statement that research is an important function of a university, and that it may be, but is not necessarily, an important function of an engineering school. But it is believed to be fair to say that those schools in which engineering research of importance is being developed, are schools in which the signs of the times are being read aright; schools in which the students even though they do not participate in research work are brought into an atmosphere that is wholly beneficial; and it is also fair to say that in the engineering schools in the West, research is being developed with some rapidity.

Mr. Alexander set forth as the objective of engineering education the providing of society with men who have had a general education and who, in addition, have been trained in a knowledge and understanding of the exact sciences through which they are enabled to promote the physical well-being of the community, and by their habits of exact thinking and constructive outlook to serve as leaders in public and private affairs.

He pointed out the need in a society of increasing complexity for exact, clear thinking on a basis of ascertained fact and experience. The training of the engineer, he said, should particularly fit him for leadership in public service as well as in industry, animated as he is by a constant spirit of inquiry, a pioneering instinct, and an openmindedness born of his scientific bent. The enhancement of these qualities Mr. Alexander conceives to be a task of the engineering schools.

Mr. Harrington offered a plea for co-operation between the four founder societies in a plan for a general undergraduate engineering society, having chapters in the several engineering schools, rather than the present student chapters of the national engineering societies. He contends that in the student sections the tendency toward specialization is carried too far and that these are failing measurably to serve the purpose for which they were formed. In this connection he cites the results of a survey of the student branches made last year by Dr. William H. Kennerson, dean of the School of Engineering of Brown University, who concluded that most student branches were sustained by artificial respiration administered by members of the faculty.

Technical Divisions

Organizing sessions of four new technical divisions were held. Such divisions were authorized by the Board of Direction last June and provided with $4,000 in the current budget of the society. The present ones deal with the sanitary, highway, irrigation and power fields.

So far each of the divisions is feeling its way along toward organization guided only by the general rules laid down by the Board. Each of the sessions, therefore, established some form of temporary organization, outlined some of the problems which the section could profitably discuss, laid plans for the program to be followed at the New Orleans meeting next April and arranged for the enrollment, through a general letter to be sent out by the society itself, of those members who wish to join the divisions. Procedure in the four divisions was not identical, nor was the status of division affiliates or the amount of dues uniformly treated, but as in each case action was only tentative, it is probable that soon there will emerge some uniform procedure, after which the sections will begin to function technically.

Broader Sanitary Engineering—Following the dinner and organization meeting of the new sanitary engineering division of the society, H. P. Eddy, consulting engineer, Boston, read a paper on the "Present Status of Sanitary Engineering," which included some suggestions on the aims of the division. He held for a broader conception of sanitary engineering than has formerly prevailed so as to include not only works and measures for the protection of public health, but also matters affecting the general comfort and welfare of the people.

In the organizing session of the highway division a great amount of discussion as to the advisability of its establishment preceded actual formation. This argument arose from the fact that there already exist some twenty-odd organizations doing research in highway work or prescribing specifications. In the face of that knowledge, however, preponderance of opinion was to the effect that the society should form a highway division.

From Job and Office

Hints That Cut Cost and Time For the Contractor and the Engineer

Sinking a Large Cofferdam Crib

BRIDGING the West Waterway at West Spokane St., Seattle, by the construction of a modern bascule bridge was begun June 9, 1922, by the award of a contract by the city to the J. A. McEachern Co., Inc., for the substructure at a price of $265,000. The bridge is to cross the 400-ft. West Waterway at an angle of 47°45′, which requires a total length of steel bridge of 600 ft., including a double-leaf bascule span of 288 ft. c. to c. of trunnions, with roadway at El. + 47, giving a clear channel between trunnion piers of 150 ft., and in order to get below the proposed future channel of 47 ft. depth of water at high tide the masonry for the main trunnion piers is to be carried to 53 ft. below high tide (El. 0).

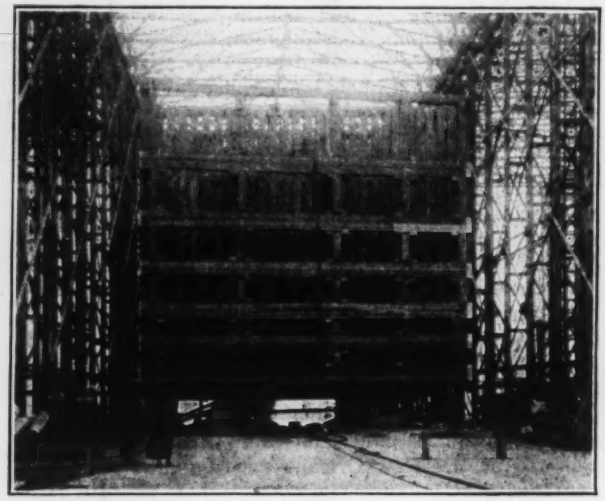
The plans for the substructure call for a pair of piers for each trunnion support 98 ft. in height, from El. —53 to + 45, each with its own concrete base and foundation of fir piling. These piers are spaced 50 ft. 4 in. c. to c. of bases, each base being 36 ft. 6 in. on the channel side, 23 ft. 6 in. on the shore side, and 42 ft. parallel to the bridge. The piles are to be driven to the considerable depth of 125 ft. below high tide at the east trunnion pier with cutoff at — 47.

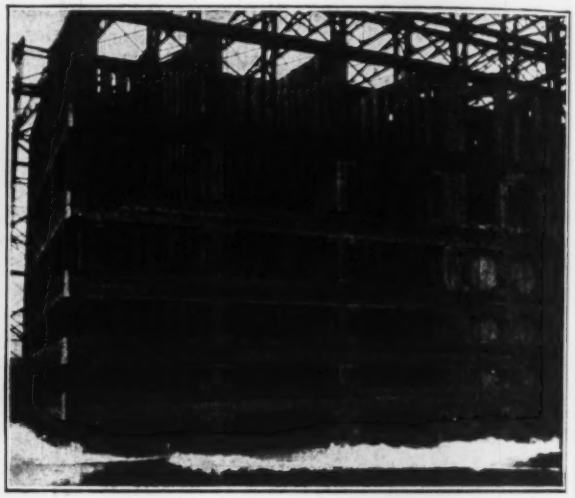
The contractors decided to construct on either side of the channel a large combined cofferdam enclosing the two trunnion pier foundations rather than two smaller cofferdams. The combined cofferdam, trapezoidal in plan, is built around a timber crib 87 ft. long on the channel side, 74 ft. on the shore side, and 42 ft. wide. The top waling timbers are at El. — 1, the bottom set of two timbers at — 36, the top of the steel sheet piling which surrounds the crib at + 2, and the bottom at — 64, which is 11 ft. below the masonry of the piers.

The west pier crib was built by the J. A. McEachern Co. at the plant of the Elliott Bay Marine Construction Co., one-half mile south of the bridge site on the West Waterway, where a number of wooden ships were built during the war.

Construction of the west pier crib began on Aug. 28, and was complete on Oct. 16. Its framing details may be judged from the view, Fig. 1, which shows the crib as it stood in the shipyard just prior to launching. It was launched Oct. 19 at flood tide, after launching ways had been extended well out into deep water to prevent the crib being strained as it entered the water.

A good view of the crib during the launching and just entering the water is shown in Fig. 2. As anticipated, the crib keeled over on one side at an angle of about 45 deg., the channel side floating highest.





FIGS. 1 AND 2—COFFERDAM CRIB ON THE WAYS AND ENTERING WATER

After entering the water, the crib, which is 87x42 ft. and 35 ft. high, heeled to an angle of about 45 deg. While it was being floated to the pier site a floating driver lifted the low side to bring the crib to even keel. The structure contains 223 thousand feet of lumber and 10 tons of steel. It will be surrounded by steel sheeting 62 ft. long, and the cofferdam thus formed is to be excavated to an elevation of 53 ft. below water.

No time was lost in towing the crib to the bridge site, and on Oct. 21, as soon as the falsework was in correct position, tugs towed the crib, with a floating piledriver lifting its low side to even keel, to the site of the west trunnion piers. Here it was floated into a berth of braced pile bents, which had been carefully located beforehand so that the crib would come to rest against vertical guide timbers. The open or channel end of the berth was promptly closed by driving a row of capped piles from side to side of the 87-ft. opening.

The area to be enclosed by the cofferdam had been excavated already to El. — 37 with clamshell buckets, the material being loaded on barges and dumped in the outer harbor. As planned, the crib was grounded at this level by loading, at low tide. The load consisted of enough 66-ft. steel sheet piling placed on top of the crib to sink it and hold it down at all tide levels. The crib careened once, toward the channel,

but mooring lines to shore held it secure and it was righted without any damage whatever being done to it.

Lackawanna 14-in. arch-web steel sheet piling 66 ft. long, which had been ordered by water shipment through the Panama Canal from the east coast specially for this cofferdam, was driven around the crib to complete the cofferdam. Each pile was picked up by a stiffleg derrick with 90-ft. boom and lowered into position, where it was driven by a drop hammer working in short leads suspended out from a floating pile-

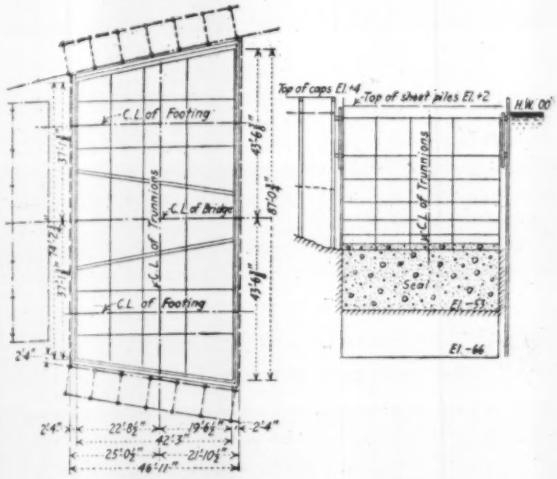


FIG. 3—WEST PIER COFFERDAM

Building a joint cofferdam for the two piers of the pair made necessary the large crib.

driver. The channel and two side walls were driven in this manner. The shore side was driven with an ordinary land driver on skids. These sheet piles were driven without jetting, although provision had been made for a jet. Piles were driven through a fine sandy material containing some blue clay, to —64. The 217 sheet piles surrounding the cofferdam were driven in ten days, ending Nov. 3.

In order to divide the big cofferdam into two foundation areas with an unused area in the center, two division walls of 4x12-in. Wakefield sheet piling have been driven, between pairs of timbers previously framed in the crib to take them.

These piles, which were 62 ft. long and extended from El. +1 to El. —61, were driven by a land driver with drop hammer, using a jet to each pile. They were driven in ten days (part time). The cofferdam is now being excavated preparatory to driving the foundation piles.

The total material in the cofferdam is as follows:

12 x 12 fir timber and blocking	125 M. ft. b.m.
Ironbark bearing blocks	3 M. ft. b.m.
2-in. plank lining pockets	25 M. ft. b.m.
4 x 12 x 64 Wakefield sheet piling	70 M. ft. b.m.
Total lumber	223 M. ft. b.m.
Iron rods, bolts, etc.	10 tons
14 x 66 ft. steel sheet piling	288 tons

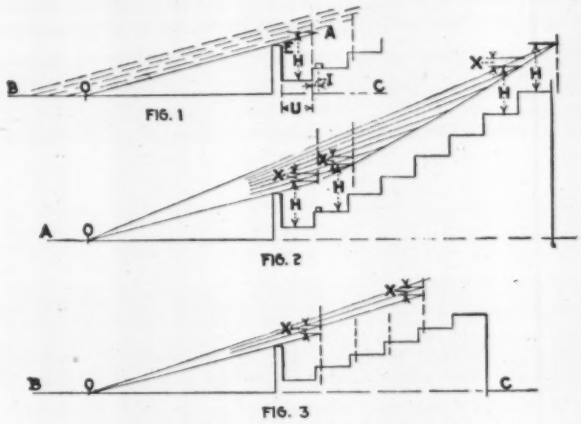
J. A. McEachern is president, B. H. Cooke general superintendent, and J. Samuelson engineer of the contracting company. The work is being carried on for the city under J. D. Blackwell, city engineer, F. A. Rapp, bridge engineer, and E. K. Triol, engineer in charge of construction.

Determining Sight-Line Factors in Stadium Design

IN THE design of a stadium it is essential to provide a good view of the arena or field from any angle or height. This desired feature can be secured only by the evolution of a proper cross-section of the structure, determined by a system of sight lines from the normal eye position of spectators in each bench to a predetermined point in the field. This feature in stadium design was described at a recent meeting of the Western Society of Engineers by B. M. Thorud, in connection with a paper on the new Chicago and University of Illinois stadiums by H. J. Burt, consulting engineer for Holabird & Roche, architects, Chicago.

To explain the sight-line system, the point *A* in Fig. 1 represents the average eye position for the first riser; *E* is the top of the field wall which the sight line must clear, and *O* is the point to which it is desired to limit the seated spectator's view. Where a running track is included it is usually around the side of the field and close to the stand. The point *O* usually then is at the height of the waist of a runner in the first or second lane of the track. This location is considered better than that wherein *O* is in the center of the track at field level. When no track is included, *O* is usually on the level of the field and somewhat outside the playing field or gridiron in order to allow a view of an "out of bounds" play.

A constant height of riser was used in the earlier structures but the later ones have variable heights. The width of tread, which is usually constant, is governed by the spectator's comfort and the number of benches necessary for the desired seating capacity in the space available for the depth of the stand. A 24½-in. width should be the minimum and 30-in. is considered



FIGS. 1, 2, 3—DIAGRAMS OF SIGHT-LINES FOR STADIUM DESIGN

ample for comfort, though for seats with backs a width of 31 to 32 in. gives better space for the knees. If any tread is to be used as a cross-aisle greater width is required.

To determine the elevation of the first tread as in Fig. 1, *O* is first located and the height and width of the field wall *E* are plotted. The aisle width *U* is laid out and a vertical line is drawn at the normal position of the eye, at the distance *I* from the face of the riser. A sight line is then drawn through *O* and *E* to this

vertical line, the intersection indicating the normal height for the eyes of persons sitting on the bench or tread.

With a constant width and rise of bench, the sight lines will be parallel, as indicated by the dotted lines. For each succeeding row the point of sight on the field B becomes farther away from the stand, so that the seat value diminishes proportionately. The advantages in convenience and simplicity of design are overbalanced by the disadvantages in poor seat values of the top benches and smaller capacity due to the limited number of treads.

If the point of sight O is constant and a constant clearance X is adopted for the height of head above the eye level, as in Fig. 2, the elevations of the risers are determined by sight lines radiating from O. By this method the height of risers increases successively.

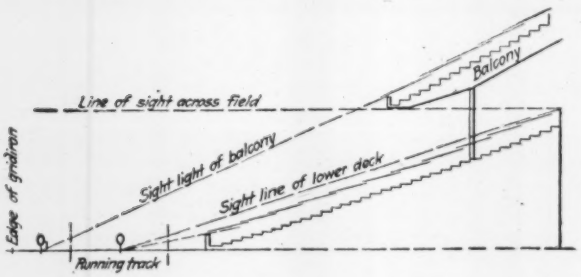


FIG. 4—SIGHT LINES FOR DOUBLE-DECK STADIUM
The effect here sought is to bring top rows closer to the field than they would be in a single deck stadium of equal capacity. Upward curvature being increased, heights of risers are greater.

It will be noted that a line drawn through the series of eye positions forms a curve. A clearance of 5 or 6 in. for X would give such a rapidly increasing curvature as to require an impracticable height of structure for the desired number of rows. For this reason a height of 4 in. has been used generally, giving risers of from 12 to 17 in. Each sight line is drawn from O to intersect its respective vertical line at a height X representing the normal height from the eye to the top of the hat of the spectator in the next seat below. The normal height of eye, H, is then measured downward from the point of intersection to give the elevation of the riser.

Since it would be impracticable to build a stand with risers varying exactly as determined by the above method, it is usual to assume a series of tangents to the curve of eye position, varying the slope of tangent to give risers differing in height by one inch.

A modification of this method is to determine the sight lines for a constant clearance X at each third row instead of at each row. This plan, shown in Fig. 3, is based on the assumption that a spectator can easily look between the heads of the spectators in the next two rows below him. In this way, with a clearance X of 5½ in. for each third row, it is possible to derive from the same point of sight O a curve of eye position having less upward curvature than that obtained in the previous method with a clearance of 4 in. for each row. The variation in height of risers will then be from 8 in. to 11 or 12 in. as compared with 11 in. minimum to 17 in. for the previous method shown in Fig. 2.

In a double-deck stadium, Fig. 4, the effect is to bring the top rows closer to the field than they would be in a single-deck stadium of equal capacity. Since this increases the upward curvature of the line through the eye positions, and consequently increases the slope of the tangent to the curve, a greater height of riser is required. Another consideration in a double-deck stadium is to fix the lowest elevation of the upper deck or balcony so that a line of sight from the top row of the lower deck will terminate at a point sufficiently high in the opposite stand to include a portion of the lower part of that stand and give a good view of an occasional punt. Since the upper deck is seldom used for track meets, its risers can be made smaller by locating the point of sight O at a distance from the edge of the football gridiron so as to include a view of a play out of bounds.

From Job and Office

Hints that Cut Cost and Time

Geophone Used in Locating Compressed-Air Leaks

AN ARIZONA mining company has demonstrated a new use for the geophone by successfully locating leaks in compressed-air lines which were buried from 1½ to 2½ ft. in fine rock fill. The following information is abstracted from data sent to the U. S. Bureau of Mines and contained in a recent bulletin of that bureau.

The mining company has two parallel main compressed-air lines about 1½ miles long buried under an average of 2 ft. of fine rock fill. One of the lines is a 4-in. high-pressure (1,000 lb.) main, the other a 10-in. low-pressure (90-lb.) main. The two mains are separated by a 10- to 30-ft. interval. Several leaks developed in the mains. Various members would be shifted to ascertain the location of leaks and finally a Bureau of Mines geophone was secured. The first tests were conducted while the pumps were running, but so much vibration was recorded that it was impossible to detect the leaks.

A second attempt was made at the close of the day shift, when the compressors were not operating and when the pumps could be shut down. The valves in the far end of the surface line were closed and the lines were pumped to full pressure. Geophone readings were then taken at 7- or 8-ft. intervals directly over the line. Several leaks, some very large in the high-pressure line, were audible with the geophone at distances varying from 15 to 30 ft. A considerable leak in the low-pressure line was found at a distance of 10 ft. After their first detection leaks were easily located. Though the largest leaks were easily discoverable the superintendent of the mining company believes that the instrument cannot be depended upon to locate the small ones.

The geophone used by the Bureau of Mines is an improved type of the French military geophone. The instrument and its uses are described by Alan Leighton in Bureau of Mines Serial No. 2102, published as Report of Investigations, March, 1920.

From Job and Office

For Contractor and Engineer

Diagram for Designing Open Ditches With 1:1 Side Slopes

By F. T. Mewes
Kelker, DeLeuw & Co., Chicago

A GREAT decrease in the time and labor required to determine the velocity of flow and discharge of open drainage ditches may be effected by the use of the accompanying diagram, which has been designed by the writer and which applies to ditches with side slopes of 1 on 1. This diagram consists of two parts: (1) A logarithmic diagram to determine the hydraulic radius and cross-sectional area of ditch for a given bottom width and depth of flow; (2) a nomographic diagram to determine the velocity of flow for a given hydraulic radius, hydraulic gradient or slope, and roughness coefficient "*n*." Since the scales of hydraulic radii for the two parts of the diagram coincide, the velocity of flow in a given channel is determined by a continuous operation.

The nomographic diagram is based on Manning's formula for velocity, as below, in which the roughness coefficient "*n*" is equal to Kutter's "*n*."

$$V = \frac{1.486}{n} R^{\frac{2}{3}} S^{\frac{1}{2}}$$

This diagram is so arranged for $n = 0.035$ (which is a common value in designing dredged drainage channels) that one operation in the general solution is eliminated. This operation is *F-G* in the following example, which indicates the method of using the diagram:

Reference to Diagram	Item	Given	Found
A	Bottom width	16 ft.	
B	Depth of flow	6.0 ft.	
B	Cross-sectional area		132 sq.ft
C	Hydraulic radius	4.00	4.00
D	Hydraulic gradient	0.06%	
E	Velocity for $n = 0.035$		2.61 f.p.s.
E	Discharge = 132 × 2.61		344 sec.-ft.
F	(General) $n = 0.030$	0.030	
G	Velocity for $n = 0.030$		3.07 f.p.s
G	Discharge for $n = 0.030$		402 sec.-ft

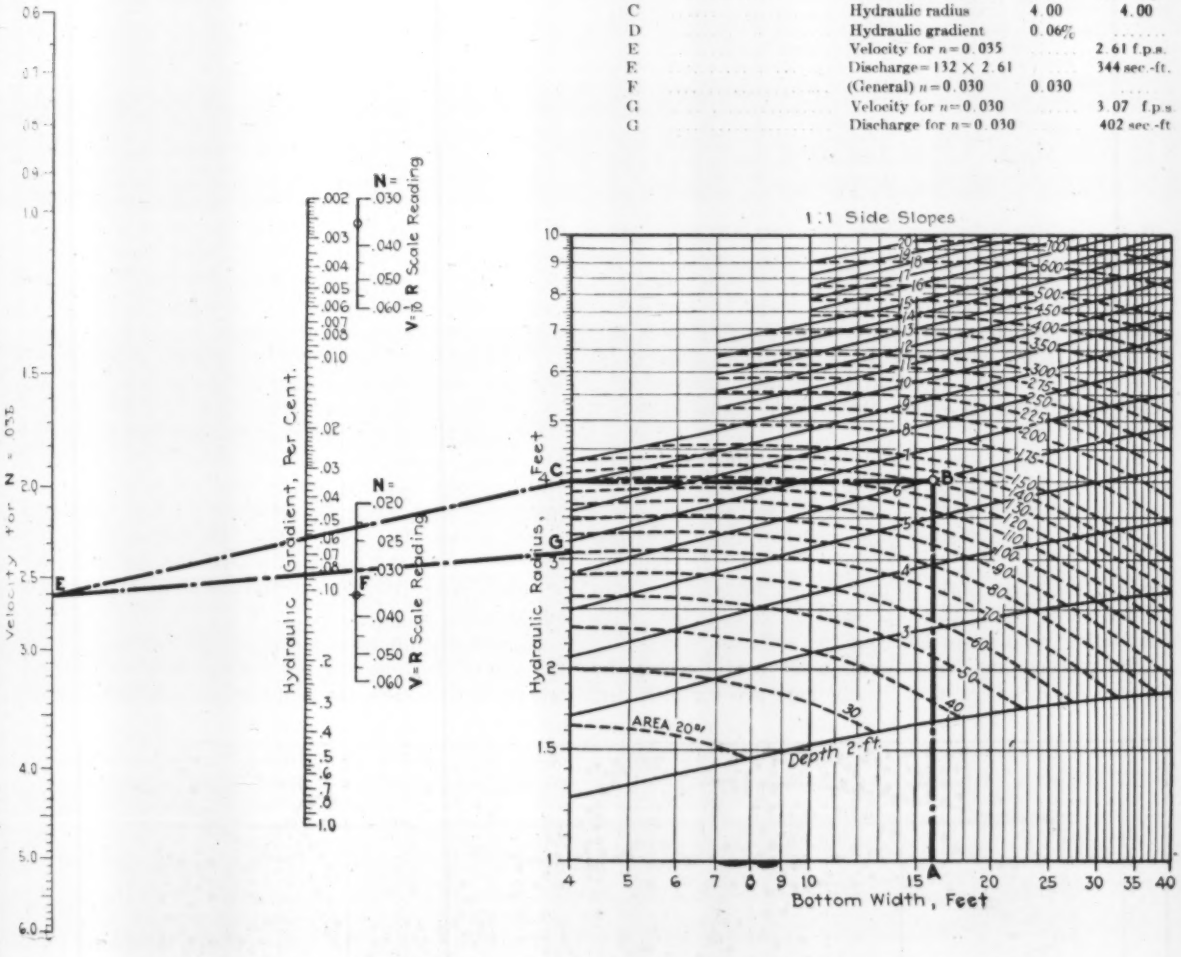


DIAGRAM FOR DETERMINING FLOW IN OPEN DITCHES

Diagram, based on Manning's formula, applies to ditches with 1:1 slopes. Inasmuch as the scale of the hydraulic radius is the same in both charts the determination of factors can be carried from the nomographic to the logarithmic chart. The use of the diagram is illustrated in the accompanying example.

For ditches with side slopes other than 1 on 1, only that portion of the diagram plotted on logarithmic paper will be changed, the nomographic diagram to the left of and including the hydraulic radius scale being the same for any channel.

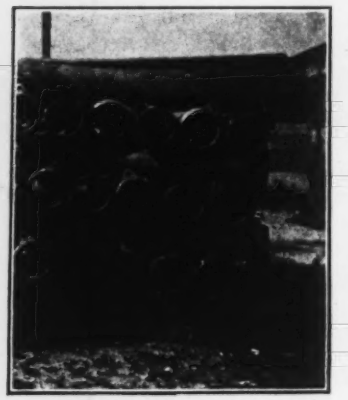
From Job and Office

Hints that Cut Cost and Time

The Right Way to Pile Cast-Iron Pipe

By George C. Love
Chief Engineer, Newport News Light & Water Company, Newport News, Va.

IN THE accompanying view is shown a very satisfactory method of storing cast-iron pipe. Though simple and rather obvious the method, its advantages may be summed as follows:



SATISFACTORY METHOD OF STORING PIPE

1—Economy of space.

2—Accessibility for thorough inspection.

3—Ease of treatment of ends to prevent rusting of machined joints.

4—Ease of piling or rehandling.

5—Stability of the pile itself.

6—Facility in making inventories.

Dotted Maps Aid in Location of Railroads To Reach Timber

AS AN aid in locating the most economical branch railroad routes to reach standing timber, an engineer of Portland, Ore., uses maps on which dots indicate both location and quantity of the timber stand. This method, illustrated by the accompanying map, can be used to show location and quantity more accurately, and maps so made are said to be more conveniently read, than maps on which the timber stand is shown by colors.

The unshaded circles each represent 100,000 ft.-b.m. of Douglas fir, and the shaded circles represent a like quantity of Sitka spruce. Streams, section and quarter-section lines, divides and railroad lines are also shown. This map is used exclusively to locate standing timber, the topography being plotted on another map of the same scale which is used in conjunction with the timber map when locating the railroad.

The method has been found most useful along the Oregon coast where very heavy logs are handled and where the greater part of the cost in production of lumber is the cost of transportation from stump to mill.

The map was prepared by G. B. Herington, consulting engineer, Portland, Ore.

More on Setting Slope Stakes

This communication from an engineer in far-off Turkey was prompted by an article which appeared in the "From Job and Office" section of Engineering News-Record, *Aug. 24, 1922, p. 303, on a simple method of setting slope stakes.*—Editor.

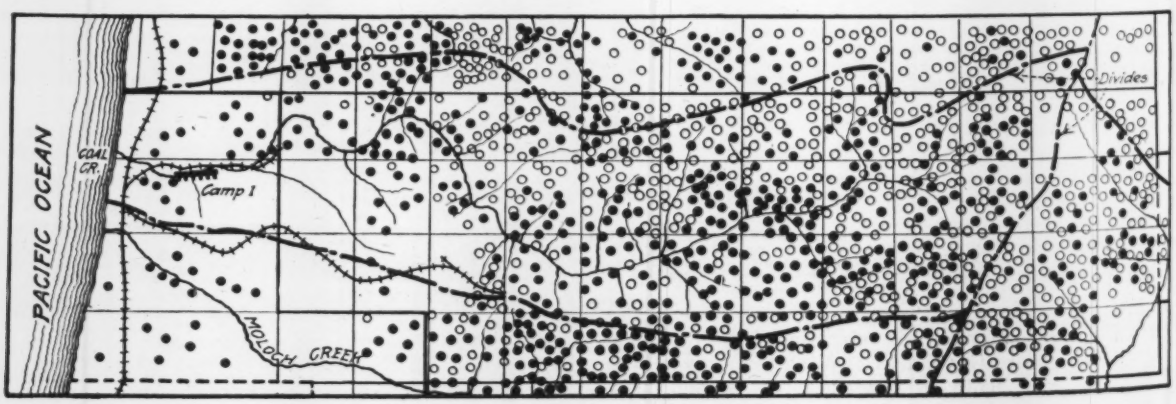
By J. C. Brown
Chief Engineer, Anatolian Railway, Constantinople, Turkey

SEVERAL years ago I used a method of setting slope stakes in work in Canada, the method involving a special rod and a specially-marked tape. The rod consisted of a pine board about 10 ft. long with a roller and an iron guard at each end. To this was attached a canvas tape which moved freely over the roller. This tape was graduated in feet and tenths from 0 to 20.

The tape was an ordinary metallic one graduated to feet and tenths and on the back, beginning at a distance equal to one-half the width of the roadbed in fill, was graduated into spaces of 1½ ft. and these subdivided into tenths. A string or wire equal to half the difference in the width of the roadbed between cut and fill was attached to the end of the tape.

Setting Stakes in Fill—When setting slope stakes the level was set up in a position to take in as many stations as possible. The rodman read the fill from the center stake, and the instrumentman checked the reading with his notes. Next, the rodman, holding the rod at the stake, moved the tape on the rod as instructed by the instrumentman until the reading on the rod was the same as the fill on the stake. It followed, therefore, that wherever the rod was placed the instrument-man at once read the fill at that spot without any calculation.

The chainman then stood at the center stake with the end of the tape and the rodman went out to a point where he believed the slope stake might come. The



TIMBER INTENSITY MAP—LINCOLN COUNTY, ORE.
Accuracy in locating the timber and convenience in reading are advantages claimed. Each circle represents 100,000 ft.-b.m. Shaded circles refer to Sitka spruce; others to Douglas fir.

From Job and Office

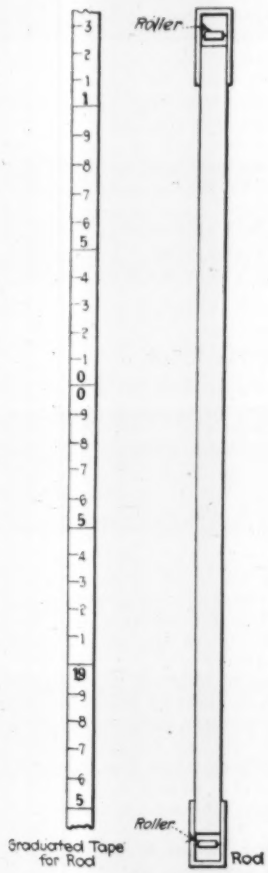
For Contractor and Engineer

instrumentman read the correct fill at that point direct from the rod and called it to the rodman who consulted the back of his tape. If the amount of fill given by the instrumentman corresponded to that shown by the back of the tape that particular point was the correct one for setting a slope stake. If the rod and tape readings did not agree, the rodman had to manoeuver until the conditions were satisfied.

When the proper place was found the rodman turned his tape over, read the distance off from the center, and called it to the instrumentman who entered it in his notes. The process was repeated on the other side and the cross-section was complete.

Setting Stake in Cut—The procedure was the same in cuts, except that the rod was held with the reverse end up. The chainman, too, held the end of the string at the stake and the rodman added the amount of the string's length to his distance out before calling to the instrumentman.

The rod could also be used to good advantage in other ways. For instance, a line of levels could be run with only one column of notes; that is, the actual elevations could be read direct from the rod. Again, a ditch could be staked out to a given gradient without figures, the rodman shifting his rod at each station a distance equal to the per cent of grade and the instrumentman reading the consequent correct cut.



SPECIAL ROD AND TAPE FOR SETTING SLOPE STAKES

Two Drafting Room Devices

A DOUBLE pen, consisting of two pen points placed in one holder with the points overlapping, as shown in Fig. 1, is a time and effort saving device for work with India ink. The filling of a pen point with a quill dipped in ink is an annoying loss of time. A fountain pen would be ideal but it cannot be used with India ink. The double pen requires only occasional filling, serving somewhat as a fountain pen.

A feature in drawing and sketching which is undesirable is that of thumb-tacking the paper to a sketch board. The paper is continuously shrinking or expanding and necessitates shifting the tacks to have the paper

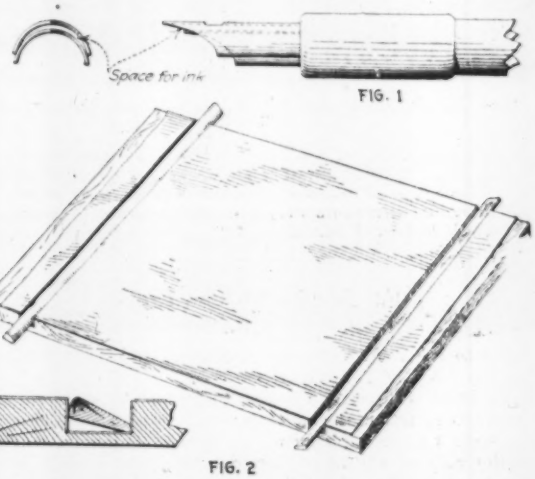


FIG. 1

FIG. 2

SIMPLE IMPROVEMENTS IN DRAFTING ROOM PRACTICE

Fig. 1—A double pen that obviates incessant inking. Fig. 2—Drafting paper is kept taut without use of thumb tacks.

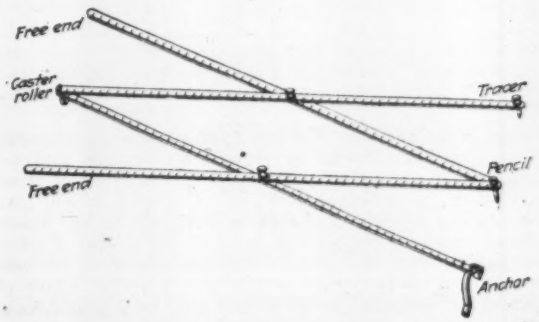
taut. To avoid this, a sketch board made with a groove and a wedging slat at each end, as shown in Fig. 2, has proved of much advantage in placing the paper. With this arrangement no tacks or tack pullers are required and the corners of the paper are not mutilated or corners of the board so perforated that they fail to hold tacks after a period of use.

The paper is made taut by pushing one of the slats into the groove while the other is in place. For thin sketch boards, where the depth of groove is limited, brass strips can be advantageously used in place of wood slats. In either case the fastenings will be below the surface of the board and the T-square will slide freely over them.—*American Machinist.*

Pantograph Roller Made From Caster

By H. D. Hurley
Massachusetts Department of Public Works, Boston, Mass.

THE standard hardwood pantograph is equipped with a metal knob on which to travel, but this device is not satisfactory, because of the uneven motion due to varying friction.



FURNITURE CASTER MAKES EASY USE OF PANTOGRAPH

As a betterment the writer procured a ball-bearing furniture caster, value 5c., filed the shaft down to the proper size and substituted this roller for the metal knob.

This change resulted in a very decided improvement in the action of the pantograph.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

For Service without Profits

Sir—Your editorial comment in the issue of Dec. 14 relating to the address by Dean Kimball on "The Engineer and the Demand for Industrial Leaders," abstracted in the same issue, fails, as he apparently failed, to understand and express the real challenge to the engineer. This real challenge to the engineering profession is for it to shake off the yoke of the financiers, owners, and business executives that has long held its members bound as servants to the big interests and corporations paying their salary checks. Those possessing the technical knowledge and skill without which the so-called "captains of industry" would be helpless must unite with the productive laborer who is also essential in any industry, to serve the public not with lip service but with real service at actual cost. The plan of the Building Guilds of Great Britain, whereby the workers and managers unite to make the contracts and hire capital at a fixed rate of interest, is an example illustrating productive industry for service. The need for similar service in the building industry in this country is all too evident. There is no greater disgrace than the present wild orgy of profiteering in cheap, jerry-built houses being sold at great profit to the man trying to establish his family in a comfortable home.

Not "service first, then profits," but service first, last and all the time rendered by well-rewarded, keenly interested, and mutually co-operating workers, is the insistent call to the new industrial leader. The danger of confusing motives of service with motives of profits is too great longer to deceive the public with the old slogan "service first." A good example of this danger is contained in *Engineering News-Record* itself. On pages 35 to 57 inclusive of the advertising pages of the issue above referred to will be found a unique example of the clever commercial instinct. Anyone who has bought a page of advertising in the *News-Record* knows what it costs. Yet here are twenty-three full pages of reading matter regarding the forthcoming Annual Convention and Road Show of the American Road Builders Association, ostensibly donated by various advertisers. If this reading matter is of value to the reader, is it service so to hide it in the advertising pages? And if not of value to the reader, why mulct the advertiser? Does not the public ultimately pay all such advertising bills? The waste involved in modern advertising is tremendous, but the commercialized journals naturally foster it by every possible device.

Rather than adopting the deceitful slogans of business, engineers should attempt to transform business and industry so that control will center not in the hands of those who, if they see sufficient profit in an enterprise will give engineers and workers a chance to work, but in the hands of those who actually manage and do the work. Professional ethics must be extended into the realm of business and industry, rather than permit the doubtful ethics of "business is business" to gain entrance into professional fields.

J. P. J. WILLIAMS.

Flushing, N. Y., Dec. 18.

[Years of experience have convinced us that the advertising pages of *Engineering News-Record* are read quite as carefully as are the editorial pages, and this letter is but another indication that our conviction is well founded. In the instance which appears to have disturbed our correspondent, the manufacturers of equipment to be shown at the Road Show adjudged it sound business to lay aside for the moment their individual stories and to encourage attendance at the show by joint effort, believing that a successful show will make for the prosperity of the whole industry, including themselves.—EDITOR.]

Why Not Abandon the Word "Engineer"?

Sir—If it were not for the editorial approval and sympathy, A. W. Bedell's letter of Dec. 16 would attract no more than a passing interest. Why single out "sales engineer" for protest, any more than "valuation engineer," "designing engineer" or any of the other engineer titles.

We, of course, all know the cigar salesman who changes his line to electric light bulbs and immediately becomes a sales engineer, but the same thing happens in any other classification; and as a rule, the successful sales engineer must have engineering ability, if not as deep, certainly as broad, as the engineer with whom he endeavors to do business. Outside of the universities, and technical schools, the sales engineer, with his data and catalogs, is the largest quick educator of engineers that we have today.

Since the word "engineer" is the cause of so much discussion and frequently irritation, why not abandon the word altogether, and each man label himself according to the work he does; for example, bridge designer, valuator, constructor, salesman, etc.?

Scranton, Jan. 4. WILLIAM L. ACKER.

Curbs for Concrete Roads

Sir—Some remarks appear warranted on the advisability and in many cases the urgent necessity of flanking concrete road slabs with curbs or wheelguards. The practice of building reinforced concrete highways without curbing is very general and the objections to this practice may be stated as follows:

The chauffeur or the driver—for it is the automobile and motor truck which are the governing factors in modern highway construction—will carefully avoid the outer, unprotected edge of the slab and 18 or 24 in. of its available width on each side may reasonably be assumed to be lost. An 18-ft. concrete roadway, for instance, will thus be practically reduced to a width of 14 or 15 ft. The impress of the tires will show this tendency at a glance. With highways of moderate width, say of 30 or 40 ft., this more or less instinctive precaution on the part of the driver is a valuable safeguard, but it only reduces, does not do away with the great danger from what may be called derailments: the getting off of the wheels from the safe, even surface of the slag to the waterworn, sloping earth or macadam outer portion of the highway and toward the edge of the slope or trench.

In the article entitled "Highway Design, Maintenance and Finance," *Engineering News-Record*, Nov. 30, 1922, p. 942, the diminishing strength of the highway slab toward its edges is referred to and an increasing thickness of the concrete with heavier reinforcement is suggested as a remedy. That the roadway slab, in fact any reinforced concrete slab free along two edges, offers less resistance to loading toward its edges is well known and can be explained through the lack of lateral adhesion between the different sections of the concrete, but in our case the fact that the outer portion of the slab rests on a less even or reliable foundation, owing to settling or washouts, is a more obvious cause. If we try to overcome this difficulty by gradually strengthening the slab toward the outside, we are left almost without guidance, inasmuch as the thickness of the concrete and the amount of reinforcement in a highway slab cannot be ascertained by calculations owing to the uncertainty of resistance from a supporting coil. Just as the railroad engineer chooses a certain section of weight of rail, not because calculations based on the moment of resistance, shear, etc., give such results, but because experience tells him so, so the highway engineer has likewise to rely solely on his judgment and experience.

The utter hopelessness of any attempt to obtain help from computations in proportioning a highway slab cannot be more strongly expressed than in the above mentioned

article itself where even the location and direction of the reinforcing steel are left open questions.

Why not then, we may be justified in asking, instead of groping in the dark, give to all our highway slabs on each side the benefit of a substantial curb or wheelguard which is bound to act as an efficient longitudinal girder supporting the relatively weaker side of the slab? Such curbing will give the engineer a chance to work out an efficient drainage system for the roadway; it will, besides, as stated above, increase the available width of concrete wearing surface and, which is more important still, add greatly to the safety of the traffic.

St. Louis, Mo. CARL GAYLER.
Dec. 23, 1922.

Economical Highway Construction—A Query

Sir—In reading two articles that have appeared in *Engineering News-Record* recently one cannot fail to be impressed with the wide differences of opinion of the two authors as to the best method of reaching a common end, "economical highway construction."

In your issue of Dec. 7, 1922, p. 971, Geo. F. Syme, Senior Highway Engineer, North Carolina State Highway Commission, takes more or less credit for his commission, because they can put a highway locating party in the field, consisting of seven or more men, three of whom are or should be engineers, keep them there one month, pay their expenses, and the additional expense of such axemen as are needed for the work, and have them locate 9.7 miles of highway at a total cost of $892.40. Apparently good management?

In your issue of Dec. 14, 1922, p. 1030, A. R. Hirst, State Highway Engineer, of Wisconsin, muses on the "fundamentals of highway department organization." Speaking of the personnel Mr. Hirst opines that the State Highway Departments need "young men of education, of promise, of courage—men who really belong." Speaking of salaries Mr. Hirst declares, "the only way to insure these is to pay salaries adequate to the work." Apparently good logic?

The writer unfortunately, or fortunately, belongs to the great class of "been theres." He can almost see the North Carolina field parties working and slaving as only men interested in their work can slave, to hold down the "cost per mile" of the survey, and after several years of work with no reward save that always to be respected reward "well done thou good and faithful servant," they enter another field where it is, at least, possible to lay aside something for the inevitable rainy day.

I wonder which of the ideas will produce the most economical highway construction.

L. W. MASBURN,
Chief Engineer, Southern Engineering Co.
Clarksdale, Miss.
Dec. 22, 1922.

Relative Merits of Cast-Iron and Steel Pipe at Ogden, Utah

Sir—In C. E. Painter's letter published in *Engineering News-Record* of Sept. 28, 1922, p. 533, attention is called to Ogden, Utah, buying a small quantity of cast-iron pipe, whereas, steel pipe had formerly been used exclusively. Mr. Painter, I understand, is a representative in Salt Lake and surrounding territory, including Ogden, of one of the cast-iron pipe foundries.

In the Ogden *Standard-Examiner* of Sept. 1, 1922, the mayor of Ogden is quoted as follows: "One of the large determining factors in the selection of cast-iron pipe was that it affords an opportunity for comparative tests." Ogden has had excellent service from the Matheson joint steel pipe installed, much of the system being over thirty years old; and there is considerable doubt in the minds of many in Ogden and surrounding territory as to the wisdom of paying a large bonus for cast-iron pipe. The cast-iron line cost $10,434 more than galvanized and asphalted M. J. pipe, the lowest bid for the latter being $38,767.

The $10,434 which could have been saved represents 27 per cent of the cost of a new line of M. J. pipe at present costs. If this saving were capitalized and put at compound interest at the 6 per cent rate of Ogden bonds, it would amount to $41,736 in 23 years, or an amount that would replace the line entirely at that time. However, experience has demonstrated that Matheson joint pipe in Ogden will last much longer than 23 years; in fact very much of the system has already lasted 33 years with excellent prospects of its lasting that much longer, except possibly such portions as may be in soil impregnated with alkali. It would be much more economical to the city to replace the portions of lines failing because of alkali, than to go to the greater expense of cast-iron pipe whose life under such circumstances is problematical. On the other hand, Matheson joint pipe can be protected against such corrosion by means now available.

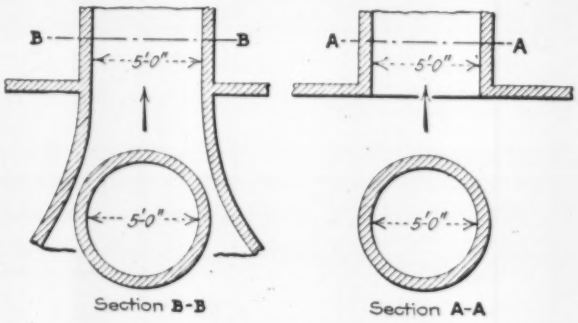
Matheson joint pipe is being used to a much greater extent, as it has been improved, and it is now regarded as a standard material by many engineers of the West. It is laid under pavement in many cities and towns, and is regarded by many as being preferable to cast iron because of its relative freedom from breakage, general reliability and greater carrying capacity.

The writer was city engineer of Ogden from 1916 to 1921, and is much interested in this subject, both from a professional standpoint and as a private citizen.

Ogden, Jan. 6. JOSEPH M. TRACY.

Relative Discharges Through Plane and Bell-Mouth Reservoir Outlets

Sir—The accompanying sketches show two reservoir outlets identical in every respect of design and operating conditions except that one extends into the reservoir in an enlarged bell-mouth shape. It is assumed that each



TWO FORMS OF RESERVOIR OUTLET

opening is entirely submerged and has the same get away. With the same head would the flow of water through each form of outlet be the same? If not, which would discharge the most and what could be expected as the maximum variation of the constants used in computing the flow through the plane and the bell-mouth shaped opening?

S. H. CHAPMAN,
Shoshone, Dec. 15. Watermaster, Idaho Districts

Permanence Antagonistic to Progress

Sir—In your issue of Dec. 28 there is an editorial dealing with "Building for Permanence." The writer cannot find himself in accord with the sentiments expressed therein. Permanence and progress are antagonistic terms. Permanence is stagnation.

Especially in the matter of dwellings does this hold true. New conveniences and comforts in living are being developed constantly, and it is vastly easier to incorporate these in new construction than to alter old construction to accommodate them, and the more permanent the construction the more difficult the task of improvement.

The present practice may entail some waste but this is the law of progress. We are constantly rebuilding our physical structures, and let us hope our mental structures as well. J. B. CHESSINGTON.

Thermopolis, Wyo., Jan. 2.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Road Builders Hold Largest Convention in History

Practically Every State Represented—Many Delegates from Foreign Countries

OVER 500 delegates participated in the long program of six sessions and thirty technical papers presented at the annual convention of the American Road Builders' Association in Chicago, Jan. 16-19, 1923. This attendance—the largest, it is believed, at any of the full score of conventions held by the association—and the high quality of the papers marked the proceedings as notable among highway engineering conferences. In conjunction with the road machinery and materials exhibition, which is reviewed elsewhere in these columns, the professional papers and discussions constituted an educational effort of notable character.

It is as a source of education that one must look to the convention for its signficance. It was evident that the delegates came to listen and learn and not to contribute opinion or information. There was very little discussion of any of the papers. This fact and the fact that abstracts of the papers are published in this issue or will be published in future issues, reduces any report of the proceedings to short space. It is possible however, while lacking the discussions from the floor and the business transactions which usually make up the news of the conventions, to note salient lines of interest in highway activity which the delegates were most concerned in pursuing.

Six sessions of the convention or, perhaps more correctly, extending the sessions into the fourth day, proved questionable. Despite subjects of wide interest and their excellent presentation, attendance was not maintained at the closing session. The third day of convention was the end as far as the attendance and interest of the great majority of the delegates were concerned. This lent an atmosphere of indifference to the wind-up of the technical proceedings which was not warranted by lack of value in the papers themselves and which was partly overcome only by the efforts of the chairman to arouse discussion from the floor.

Besides the news report of the Road Builders' convention on this page, abstracts of a number of papers read will be found on pp. 153-157, inclusive. These papers relate to the most recent practice in all branches of highway engineering, and were read at the convention by both highway engineers and executives. In addition to the five pages of abstracts a comprehensive report on pp. 184, 185 and 187 describes equipment and materials exhibited by manufacturers at the Road Congress.

Each session was devoted to a different general phase of highway development: At the first session general policies, then design and research, construction, maintenance, traffic and finance. A part only of one session was devoted to the election of a nominating committee and the adoption of resolutions, since the annual business meeting of the association is held at another date and separately from the technical convention and the road show.

Outstanding interest was shown in the research records which were presented from the Bates Road, by Clifford Older, from the Pittsburg Road, by Lloyd Aldrich and from the Arlington test farm, by A. T. Goldbeck. Discussion, beyond mere query for further explanation, was confined to comment on the Bates Road tests by Prevost Hubbard who discounted the significance of the tests in indicating comparative merits of types of pavement. The same doubt was voiced by Will Blair, commenting also on the Bates Road records.

At the construction session the three papers on haulage—industrial railway by A. J. Parrish, heavy truck by Charles H. Fry and light truck by A. E. Horst—drew the largest attendance of any session. Largely a statement of conclusions and tabulations of statistics based on experience, these papers did not lend themselves to impromptu discussion and they will be published condensed in a succeeding issue. A paper by H. E. Kuelling on local gravel pit equipment and operation, outlined methods of field location, equipment, operation and costs as determined by actual experience in Wisconsin. The essential facts of this paper will be published in a future issue. Delays in highway construction by H. K. Davis and B. H. Piepmeier and Winter Construction by J. H. Mullen were lost-time questions excellently handled in three papers.

Maintenance Discussed

Maintenance was the subject of five papers by six authors, both W. A. Van Duzer and A. W. Muir writing on macadam road salvage and maintenance. Maintenance organization was discussed by Frank Page who recited the practice in North Carolina by which in a few months a state system was put under intensive maintenance. Results of five years patrol maintenance in Wisconsin analyzed and summarized by J. T. Donaghey were made the proof of perhaps the strongest argument which has been made for state maintenance through county organizations. An extensive abstract of the paper will be published. In the matter of maintenance detail, L. H. Nielsen spoke on gravel-roads and W. H. Root on earth-road maintenance.

In the closing sessions on traffic and finance, A. R. Hirst spoke on the development of tourist traffic, the methods of nurturing it and its valuation as a factor in highway development. J. N. Mackall and Harry Meixell, Jr., presented different phases of the traffic situation in papers on motor vehicle legislation. Speaking as a banker and a former superintendent of roads of Illinois, S. E. Bradt presented an encouraging paper on "Have Large Expenditures Changed the Public Attitude Toward Highway Development?" His conclusion was that generally there was no continued reaction to be feared.

At the single part-session devoted to business, a number of resolutions pertaining to the convention proceedings and to minor matters were passed and in particular a resolution urging Congress to give the authorization required for the United States to become a member of the Permanent Association of International Road Congresses.

Moffat Tunnel Suit to Go to Supreme Court

Opponents of the Moffat Tunnel project in Colorado have announced their intention to carry the case to the U. S. Supreme Court following the denial of the petition for a rehearing of the case by the State Supreme Court which rendered a decision favorable to the project.

In commenting on the delay the *Official Bulletin* of the Colorado Engineering Society indicates that the period of delay may be used advantageously to draw and execute contracts with those who may use the tunnel since the law provides that the Board may require any of such contracts to be entered into before the beginning of the construction or expenditure of funds if in its judgment it is deemed expedient. The engineers hold that the act of entering into such contracts would enlist the confidence of the people as to the sincerity of the railroad interests. Further they ask if there is any reason why the city of Denver should not arrange definitely to use the tunnel to bring water it needs from the Western Slope.

Commission-Manager Administration Effective at Astoria, Ore.

The commission-manager form of government went into effect at Astoria, Ore., on Jan. 1, with O. A. Kratz as city manager. All the administrative officers appointed by Mr. Kratz were confirmed by the commission, including the following: city engineer, Robert A. McClanathan; superintendent of waterworks, Albert Johnston; superintendent of streets, J. McAllister.

Railway Construction Authorized

The Florida East Coast R.R. has recently secured authorization from the Interstate Commerce Commission for the construction during the next five years of a 133-mile line between Okeechobee and Lemon City, a suburb of Miami, Fla. The cost of the project is estimated at close to $5,000,000.

New Administration Under Way in Am. Soc. C. E.

The new Board of Direction elected at the annual meeting of the American Society of Civil Engineers as noted in these columns last week, held its first meeting immediately following the business session of the society at New York last week. The new executive committee will consist of C. F. Loweth, Robert Ridgway, George S. Webster, Frank E. Winsor and Clifford M. Holland. The committee on technical activities and publications comprises Richard L. Humphrey, C. E. Grunsky, Joseph J. Yates, John P. Hogan and John N. Chester.

The annual convention for 1923 is to be held at Chicago sometime during June or July and the technical session probably will be devoted to a discussion of railroad terminal problems. The fall meeting will be held somewhere in District 5. Invitations have been received from Washington, Norfolk and Richmond and the matter has been referred to the committee on technical activities and publication, with power. As already announced, the spring meeting will be held at New Orleans on April 18, 19 and 20.

The committees appointed by the president to prepare the arguments that will accompany the referendum ballot as to whether the society shall join the Federated American Engineering Societies are: For the favorable arguments: R. L. Humphrey, G. G. Anderson and A. P. Davis; for the opposition arguments: C. M. Holland, F. E. Winsor and W. L. Huber.

S. T. Wellman Memorial Meeting

On the evening of Jan. 9 the Cleveland Engineering Society and affiliated technical societies held a meeting in memory of the late Samuel T. Wellman, one of the pioneers of the steel industry. The principal addresses were made by J. H. Stratton, Ambrose Swasey and John McGeorge. A number of other men long connected with Mr. Wellman's technical activities gave reminiscences of his career as steel manufacturer, inventor, and builder of industrial machinery. Special tribute was paid to his services to the world in making the openhearth steel furnace a practical success in the United States and in his invention of the charging machine for openhearth furnaces.

War Department Approves Chicago-Calumet Harbor

A permit for the construction of a municipal harbor in Lake Calumet has been granted to the city of Chicago by the Secretary of War. The plans, as outlined in *Engineering News-Record*, April 21 and Aug. 4, 1921, p. 673 and 209, provide for a broad basin with 21 ft. of water and having slips on either side. Filling the adjacent low-land and marshes will provide about 1,450 acres for terminal and industrial development. The state legislature has already granted the bed of the lake to the city and the U. S. government has dredged a deep channel in the Calumet River as an outlet to Lake Michigan. Dredging and dock construction is estimated to cost $3,500,000, exclusive of pier sheds and terminal facilities to be provided.

Am. Soc. C. E. Resolution Asks Speedy Trial of Alleged War Fraud Defendants

The full text of the resolution passed at the Jan. 17 session of the Am. Soc. C. E. expressing concern over indictments of some of its members for alleged war construction fraud follows:

Whereas, **the Board of Direction of the Am. Soc. C. E. has been greatly shocked by the indictment of several of its members and the institution of civil suits to recover millions of dollars from others for alleged war frauds, especially in view of the stigma and other immediate serious consequences under which they are placed by the wide publicity given to these charges, and**

Whereas, **these and many other members of our society responded to the call of their government and rendered invaluable service throughout the Great War, and**

Whereas, **the Constitution of the United States guarantees to every accused citizen a speedy trial; therefore**

Be it resolved, **that this Board believes that every instinct of justice demands that these charges be immediately tried in order that the guilty may be punished and the innocent may be freed of the serious accusations which have been made against them; and**

Be it further resolved, **that copies of this preamble and this resolution be sent to the President and attorney-general of the United States and to the presiding officers of the Senate and House of Representatives.**

Handling of Coal Traffic Reveals Railroad Deficiencies

Washington Correspondence

Railroad performance in the handling of coal since the close of the strike has been studied and analyzed more carefully than ever before. The conclusions that are being reached do not reflect credit on the railroads. When the figures are all compiled, it is believed they will prove conclusively that railroading efficiency is very low.

These figures will show also, it is believed, that in addition to the poor handling of cars the principal causes of transportation deficiencies will be found in the lack of motive power and in the inadequacy of terminal facilities. The railroads have enough open-top cars, actually engaged in the transportation of coal, to move the entire requirements of the country if each car will average thirteen trips a year. It is believed that even a better movement is within the range of good management. At present, the average railroad car in service is twenty days unde1load and 2.2 days in movement, but it is earning revenue during only 1.5 days.

This year's careful scrutiny of transportation conditions will develop, it is believed, that bottle-neck and expensive terminals must give way to expanded facilities and the sale of high-priced, close-in terminals.

News Brevities

The third annual New Jersey State highway convention is to be held at the Stacy-Trent Hotel, Trenton, Feb. 14-17. In addition to technical papers and discussions there will be a highway industries exhibit.

The Northern Pacific Railway Co. has announced plans for the purchase of about $17,000,000 worth of new equipment to be delivered largely during the current year. The order consists of 5,280 new freight and express cars and 49 locomotives.

Two railroad systems with terminals in Chicago have announced proposals to expend an additional $22,000,000 for new equipment. The Illinois Central has asked bids on equipment aggregating $15,000,000, consisting of 50 locomotives and 4,670 cars. The Chicago & Northwestern has announced an appropriation of $7,000,000 for 3,000 additional cars to be delivered early in the spring.

To advise the directors of the Pueblo Flood Control District three consultants have been employed: P. D. Fitzpatrick, chief engineer, Vermont Central Ry.; Prof. S. M. Woodward, University of Iowa; and Prof. L. G. Carpenter, consulting engineer, Denver. The directors must adopt an official plan, which is being worked out by the Dayton-Morgan Engineering Co., and a period allowed for filing objections before arranging for finances or starting construction.

Col. Henry S. Graves, dean of the Yale School of Forestry, and chief forester of the United States from 1910 to 1920, has been elected president of the American Forestry Association. Dean Graves graduated from Yale in 1892. After graduate study of forestry at Harvard and the University of Munich he was associated with Gifford Pinchot, consulting forester. When Mr. Pinchot became chief forester in July, 1898, Mr. Graves became his first assistant. From 1900 to 1910 he was director of the Yale Forestry School.

Health lectures and demonstrations for officers and nurses given for five years past under the supervision of the New York State Department of Health are to be supplemented this year by short courses for sanitary inspectors and operators of water-works and sewage-works. The course for sanitary inspectors will be given on Feb. 5, 12, and 13, and for operators of water-works and sewage-works on Feb. 19 and 20. Both courses will be given at the Albany Medical College, located in Albany, N. Y.

The City of Detroit recently sold $20,163,000 of bonds for public improvements. Of these, $7,945,000 bear interest at 4½ and $12,218,000 at 4¼ per cent. The bonds sold at a premium of $61,900, making an average yield rate of 100.307. The bonds are to be used as follows: Water supply, $5,230,000; street railway, $3,280,000; sewers, $2,665,000; Belle Isle bridge, $2,100,000; lighting, $1,368,000; miscellaneous, $5,520,000.

Los Angeles Permitted to Empty Sewage in Ocean

Screens, Outfall 5,000 Ft. Long and Other Limitations Set By State Board of Health

The California State Board of Health has granted a permit to the City of Los Angeles for the disposal of sewage effluent in Santa Monica Bay provided:

(1) That within eight months all sewage reaching the ocean shall first be passed through screens with slots not more than ⅛ in. wide and that within two years the discharge shall be from the outer end of an outfall extending at least 5,000 ft. from low-water shore line on the bay bottom.

(2) That disposal shall be so conducted as not to cause anything recognizable as of sewage origin on adjoining beaches.

(3) That the quality of water at adjoining beaches which, in the absence of Los Angeles sewage would be safe and suitable for public bathing purposes, shall not be brought below such bacterial standards for salt water bathing beaches as may be established by the State Board of Health.

(4) That no objectionable odors shall be caused at adjoining beaches.

(5) That the operation of the sewage works and the disposal of screenings shall not be a menace to health.

And (6) that additional treatment and changes or improvements in the outfall shall be made when required by the State Board of Health.

The restrictions applying to adjoining beaches do not apply to Hyperion Beach owned by the city and where the outfall enters the ocean.

Great Falls Power Unit Operates

The first power unit of the Manitoba Power Co.'s 56,000-hp. development at Great Falls has gone into operation and is working satisfactorily, relieving the power shortage experienced by the Winnipeg Electric Railway Co., and furnishing a surplus for sale.

Los Angeles Union Terminal Order Upset by Supreme Court

The California State Supreme Court recently annulled the order of the California State Railroad Commission which directed the principal railways entering Los Angeles to join in the construction of a union passenger terminal at what is known as the Plaza site. Announcement of final action by the Railroad Commission on this plan was published in *Engineering News-Record*, Dec. 22, 1922, p. 1039.

Last January the railroads instituted proceedings before the Supreme Court to annul the commission's order, contending that the commission had exceeded its jurisdiction in ordering a union terminal depot and that only the Interstate Commerce Commission had the authority to direct such activities by railroads engaged in interstate commerce. In the Dec. 19 decision the court upheld this contention and ruled that "We arrive at the conclusion that full power and authority over the matter of union terminal depot facilities of the railroads largely engaged in interstate commerce have been vested in the Interstate Commerce Commission and that the state commission has been divested of this power."

Grade crossing accidents were a potent factor in the demand for a union terminal and consolidation of rail facilities in Los Angeles included plans for the elimination of all steam-line grade crossings in the city. In case the court's decision applies only to the terminal itself, the city has announced that it will endeavor to have the grade separation program carried out.

The State Supreme Court is the final tribunal in the interpretation of state constitutional rights and if the decision, which has not yet been given out in full, is based on constitutional interpretation, no appeal can be made. The State Railroad Commission has announced that it will apply to the Supreme Court for a rehearing of the case and in the event that the decision is final, will place the matter before the Interstate Commerce Commission in an endeavor to accomplish the desired results.

Ford Buys Plant Site Near Dam on Mississippi at St. Paul

The Ford Motor Company has purchased 167 acres of land in the southwestern part of the city of St. Paul, Minn., on the banks of the Mississippi River and has filed a petition with the Federal Power Commission for permission to develop the power now going to waste at U. S. Lock and Dam No. 1. The use of this power has been the cause of a long-drawn-out conflict between St. Paul and Minneapolis, as outlined in the *Engineering News-Record*, Dec. 28, 1922, p. 1135. The Ford company, in its petition, has agreed to pay a reasonable amount to the government for the use of that portion of the dam devoted to power purposes, estimated to be between $50,000 and $100,000 per year. It has also agreed to provide, at its own expense a modern hydro-electric experimental and testing station for the use of the University of Minnesota, and to make its shops available for the training of students in St. Paul and Minneapolis.

The Ford company has agreed to start work in the spring of this year on a plant for the distribution and assembly of its products, regardless of whether it obtains the water power. If it obtains this grant it will extend its plant at a cost of $10,000,000, for the purpose of manufacturing automobiles and farm tractors, and will employ about 14,000 men.

The Chicago, Milwaukee and St. Paul R.R. Co. has agreed to build a line from the point where its Iowa and Minnesota Division crosses the river to the Ford plant and to extend this line to a connection with an existing branch in Minneapolis, routing through trains over this new line.

The city of St. Paul is drawing the necessary ordinances to set aside an area between the new plant and the river on the south for park purposes; to obtain an extension of the trolley system to the new plant and extend the same across the river to Minneapolis; to do the necessary paving and improvements to make the plant accessible to vehicular traffic; and to vacate all streets in the area bought by Ford.

Ford proposes to build and equip a fleet of barges for the handling of raw and finished products on the Mississippi river. In that event, suitable wharves will be built south of the plant, with a tunnel connection between the two.

92-Foot Poles Hauled 20 Miles on Two Motor Trucks

These poles were used by the Pacific Gas and Electric Co. on the Pit River Power Project. Two of these red fir poles were set up over the turbine pit at Pit River Power Plant No. 1 and used in erecting machinery. Thirty ton sections of the scroll case units were lifted into place and assembled by this equipment. The grades over which these poles were hauled by the motor trucks were estimated at about 10 per cent. The trucks had to work on about a 100-ft. radius in making turns

The head driver drove the truck so as to clear the front end of the pole and the rear driver kept the rear end clear. The front driver signalled to the rear driver by means of a loud whistle. There was a false bolster on each truck, with a chain wrap and a screw jack over the pole to tighten the chain. The chain was attached to the bolster by a pin. There was just enough play over the top of the pole to enable the truck to swing on the bolster when rounding curves. Bolsters were securely bolted.

Dr. Brown Made Acting Director of U. S. Standards Bureau

Dr. Fay C. Brown, since the World War assistant director, has been appointed by Secretary of Commerce Hoover acting director of the U. S. Bureau of Standards. Dr. Brown was born in Washington, Ohio, in 1881 and was graduated from the University of Indiana. After graduate work at the Universities of Illinois and Chicago he took his doctor's degree at Princeton in 1908. For a time he was an instructor in physics and engineering at the University of Illinois and later joined the faculty of the University of Iowa. In 1917 he entered the military service in the Ordnance Department and was put in charge of testing and ballistic work on airplane bombs. While in the military service he attained the rank of major.

G. W. Buchholz to Leave A.G.C.

G. W. Buchholz, who for the past three years has been general secretary of the Associated General Contractors of America, will sever his connection with the association Feb. 15 to become eastern manager of the W. M. Sutherland Building & Contracting Co. of St. Louis. However, Mr. Buchholz' offices will be maintained in the Munsey Building, Washington, D. C.

Mr. Buchholz joined the A.G.C. Feb. 10, 1919, when headquarters of the association were in Chicago. During his three years' connection with the association he traveled and met with contractors in every state in the country and has gained a wide friendship.

Grand Trunk Agrees with City on Detroit Grade Separation

The Grand Trunk Ry. has signed an agreement with the city of Detroit providing for grade separation on Dequindre St. from Jefferson Ave. north to Erskine St., on the basis of the city's plan for depression of the tracks. The total cost is estimated at approximately $4,000,000. According to the agreement, the city will bear 25 per cent of the physical cost of making the depression and the railroad company 75 per cent. The city is to pay also the total cost of damages awarded to the abutting property owners.

The depression will vary from one foot at Jefferson Ave. to 20 ft. at Erskine St. in a distance of approximately 1½ miles. Twenty-two city blocks and six street railway lines are crossed. It is planned to begin work within a few months at Jefferson Ave. and it is agreed to have the first sixteen crossings made by Dec. 31, 1929, and the remaining separation program to Erskine St. completed by Dec. 31, 1933.

The agreement ends a long controversy between the city and the company. The company's plan favored elevation of the tracks and numerous hearings were held before the question was settled. The Michigan Public Utilities Commission, before which the final hearing was held, approved the city's plan.

John W. Reid, present city engineer of Detroit, was for several years grade separation engineer and worked out the plan which was finally agreed to.

Sixteenth St. Bridge in Pittsburgh Opened to Foot Traffic

Virtual completion of the new Sixteenth St. bridge across the Allegheny River in Pittsburgh was indicated on Jan. 1 when the footwalks across the bridge were opened to pedestrian traffic and a private ferry which had operated at the crossing since the old structure burned in 1920 was discontinued. Pavement is yet to be laid on the buckle-plate floor of the roadway, which work is not likely to be completed until summer.

The bridge comprises three steel arch-truss spans of the braced-rib type with tie in the plane of the floor. The spans are 229, 437, and 229 ft. long.

New Jersey Road Commissioners Removed by Governor

The New Jersey State Highway Commission has been removed by Governor George S. Silzer who states that he will not immediately appoint a new commission. In the message to the state legislature announcing his action, the governor asked that legislation be enacted providing for a commission of three instead of eight members.

Bridge Across Golden Gate Again Proposed

Plans have again been brought forward for a bridge across the Golden Gate at the entrance to San Francisco Bay, this time by J. B. Strauss of Chicago, who proposes a toll bridge to be erected by private enterprise at a cost of $17,500,000. The plans call for a combination cantilever and suspension span, 4,000 ft. long, of which 2,200 ft. would be a cable suspension section slung from the ends of two 900-ft. cantilever arms. The towers at either end of the main span would be 1,000 ft. high and there would be two shore spans, each 1,320 ft. long. A roadway 90 ft. wide is proposed with provision for two interurban tracks to carry 30-ton cars, two highways and two sidewalks. The clearance between the bridge and water level would be 200 ft. At this point the channel is about 300 ft. deep.

The San Francisco Chamber of Commerce has endorsed the project and the well known firm of McDonnell & Co., stock and bond brokers, has offered to undertake the raising of the $17,500,000 as a matter of public service without profit to the firm.

Morrow Tells of Panama Canal Maintenance and Operation

At a regular meeting of the New York Section of the American Society of Civil Engineers on Jan. 10, Governor Jay J. Morrow of the Panama Canal Zone described in detail the administration, maintenance and operation of the canal. His address, which was illustrated by lantern slides and motion pictures, was heard by a large audience which included many representatives of other local engineering societies, present as the guests of the section.

Governor Morrow touched but lightly the problems of construction, but dwelt upon the handling of ships, the canal terminals and their transfer and overhauling facilities, the water supply of the summit level and the plans to insure its adequacy, the struggles against the slides and the government and business administration of the canal zone. He referred briefly also to the perennial lock vs. sea-level controversy and pointed out the wisdom of the decision that gave us the lock canal.

In connection with the finances of operation Governor Morrow declared that it is now a fact that all the expenses for operation, maintenance and administration are about one-half the sum the canal turns into the Treasury, and that the canal nearly pays interest and amortization on the investment. Traffic has increased from 4,000,000 net tons in 1915 to more than 11,000,000 net tons in 1922. It is estimated that during 1923 it will almost certainly exceed 13,000,000 tons.

A. St. Laurent Elected President of Canadian Engineers

A. St. Laurent, who was appointed a year ago chief engineer of the Department of Public Works of Canada, was elected president of the Engineering Institute of Canada at the annual business meeting held in Montreal Jan. 23. Mr. St. Laurent has been in the Department of Public Works for the past 34 years, having been first appointed in 1888. He became assistant chief engineer of the Department in 1906 and two years later was made assistant deputy minister, which office he continued to hold until February, 1922.

Mr. St. Laurent was born in Rimouski, Province of Quebec, in 1859, where he received his early education. He was graduated from Montreal University. In 1885-6 he was engaged on railway location, construction bridge and trestle work in eastern Quebec. In 1888 he entered the service of the Public Works Department of Canada at Ottawa as principal draftsman and as principal assistant on harbor surveys, etc. In 1891 he was made assistant engineer in the Winnipeg office which was in charge of the departmental operations in northwestern Ontario, Manitoba, and the Northwest Territory. In 1898 he was transferred back to headquarters at Ottawa as principal assistant engineer in charge of designs and contract plans for a lock and dam at St. Andrews Rapids on the Red River. Other work over which he had supervision included a traffic bridge across the North Saskatchewan River at Edmonton, the lengthening of the dry dock at Levis, Quebec, and alterations to the dry dock at Kingston, Ont. In 1902 he was in charge of the construction of the Laurier bridge at Ottawa and of grain elevator No. 1 at Montreal Harbor. During that period he was acting as assistant chief engineer and in charge of the chief engineer's office on several occasions.

N. Y. Merchants' Association Completes Transit Study

Following an exhaustive analysis of the plans proposed by the New York Transit Commission and by Mayor Hylan for the extension of the New York transit system, a committee of the Merchants' Association of that city has reported strongly in favor of the Transit Commission's plan. The committee is headed by Col. F. A. Molitor and includes also Theo. Beran, Jules R. Breuchaud, William C. Demorest, Jacob M. Gidding, J. K. Robinson, Jr., and Walter Stabler.

The report, which has been approved by the board of directors of the association, recommends that the organization go on record in favor of the principles embodied in the Transit Commission's proposal and that, whether or not the new state administration may deem it wise to change the control of rapid transit matters, the experience and judgment involved in the commission's plan be preserved and utilized in the solution of the problem.

Extensive Flood Damage in Oregon

Floods in Oregon during the first week in January seriously damaged bridges and highways. The Willamette River reached the highest stage in 33 years, and because of drift accumulations against piers both the Burnside and the Morrison Street bridges across the Willamette in Portland were closed. The Morrison Street bridge was reopened after tugs had cleared log jams lodged against the piers, but Burnside bridge will remain closed pending inspection by divers to ascertain whether scouring occurred around piers.

Traffic over several main and branch line railroad routes throughout the northwest had to be diverted or discontinued. The Santiam River swept away bridge approaches and several hundred feet of Southern Pacific main line and Oregon Electric Ry. tracks. An acute water shortage at The Dalles was caused by a break in the principal water supply line. Oregon City's water supply was also cut off, with only two days' supply in the distributing reservoirs.

Extensive undermining of pavement occurred throughout western Oregon. Scores of small bridges have been damaged or swept away entirely, in some cases the piers also being washed out. Inconvenience caused by curtailment of motor stage service emphasizes the extent to which this means of transportation has become essential.

Damage in Washington is heavy in some quarters but in general it is much less serious than in Oregon. Olympia as well as other Washington cities were for a time isolated by breaks in power, telegraph and telephone lines.

Steamer to Pay for Wrecking Bridge Over Hackensack

Destruction of the Hackensack River drawbridge on the Lincoln Highway, near Jersey City, on June 22 (reported in *Engineering News-Record*, June 29, p. 1095) caused a loss to the state of $126,472, according to an estimate just completed by a board reporting to the State Highway Commission of New Jersey. It is expected that $100,000, representing about 80 per cent of the loss, will be charged to the company owning the steamer which wrecked the bridge, as settlement for the damage caused.

No Abnormal Unemployment

Washington Correspondence

There is no conflict between recent statements made by Secretary of Commerce Hoover and Secretary of Labor Davis as to unemployment. Secretary Hoover explains that he did not say that there is no unemployment. He did say that there is no unemployment problem. Secretary Davis at about the same time declared that there are 1,500,000 wage earners in the country who are "not attached to any payroll."

At Secretary Davis' office it is explained that this figure represents the normal unemployment. It is the irreduceable minimum, he believes. There always is a floating pool of unemployed, due to the seasonal character of many industries and the fact that shifts from one type of employment to the other do not coincide precisely.

Western Society Convocation to Be Held February 1

The Western Society of Engineers will hold its second midwinter convocation on progress of engineering enterprises in Chicago, February 1. Speakers on sewers and sewage are: George C. D. Lenth, Harrison P. Eddy, and Langdon Pearse; on water supply, Dabney H. Maury, Louis R. Howson, and Myron B. Reynolds; on fire protection, Clarence Goldsmith; on central station development, past and future, Samuel Insull.

Engineering Societies

Calendar

Annual Meetings

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington, D. C.; Annual meeting Los Angeles, Jan. 30-Feb. 3.

NATIONAL HIGHWAY TRAFFIC ASSOCIATION, New York; Annual Convention, Cleveland, Feb. 19-20.

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago; Annual Convention, Chicago, March 13-15.

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; Annual Convention, Norfolk, Va., May 7-9.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Annual Meeting, Atlantic City, N. J., June 25-29 or 30.

The Engineers Club of Northern Minnesota at its annual meeting held at Hibbing on Jan. 8, elected the following officers: Edward Loye, engineer with Oliver Iron Mining Co., president; L. C. Moore and C. J. Galvin, both of Hibbing, vice-president and secretary-treasurer respectively.

The Buffalo Section, American Society of Civil Engineers, at the bi-monthly meeting on Jan. 16 was addressed by Major Geo. H. Norton, city engineer of Buffalo, on Buffalo's water front and harbor improvements. Plans are now under way for a comprehensive study of Buffalo's harbor by federal, state and municipal authorities and Major Norton outlined these efforts and described the work now under construction by the city of Buffalo. Major Paul Reinecke, Corps of Engineers, U. S. A., district engineer, was a guest at this meeting.

The Colorado Engineering Council has been widening its sphere of influence by increasing its representation. The Colorado Chapter of the American Society of Heating and Ventilating Engineers and the Rocky Mountain Association of Petroleum Geologists are recent acquisitions. With the Colorado Section of the American Chemical Society, which has applied for admission, the council will consist of twelve member societies.

The Seattle Engineers Club during the holidays played Santa Claus to 85 children from the Washington Childrens' Home. This is the fourth annual affair of the kind, and included a large Christmas tree, entertainment, banquet and presents for each child. C. W. Croasdill was chairman of the Christmas committee.

Personal Notes

GEORGE P. COLEMAN resigned as state highway commissioner of Virginia on Jan. 18, stating that he did so in order to be free to do those things which he thought "necessary for the proper advancement of the highway interests which mean so much to the development of Virginia." Mr. Coleman had been connected with the state highway department since its organization in 1906 and since 1912 had been state highway commissioner. During that time he had laid the basis of the state's highway system, advocated and seen enacted into law much progressive highway legislation, and constructed over 7,000 miles of highways. He has been president of the Virginia Good Roads Association, president of the American Association of State Highway Officials and president of the American Road Builders' Association. He served as chairman of the committee which prepared the federal-aid highway act.

O. D. STREET, lately general manager of distribution of the Western Electric Co., has been elected vice-president of McGraw-Hill Co., Inc., in executive charge of a unit of six electrical journals published by the company.

NELSON F. PITTS, junior assistant city engineer of Syracuse, N. Y., has been promoted to deputy city engineer. He succeeds WILLIAM A. GERE, retired under the new pension law for municipal employees. WILLIAM F. KAVANAUGH will probably be named engineer in charge of paving to succeed Mr. Pitts.

T. D. CLAIBORNE, of Baltimore, Md., formerly with Claiborne, Johnston & Co., Inc., announces his withdrawal from that company and that with August Mencken and H. M. Gittings he has incorporated the T. D. Claiborne Co., Inc., to do a general contracting business.

JAMES M. CREMIN has been appointed for a four-year term as a member of the California State Reclamation Board, succeeding Grover C. Shannon.

F. H. COTHRAN, formerly division engineer of Southern Power Co., with headquarters at Charlotte, N. C., is now resident manager of the Quebec Development Co., Ltd., at St. Joseph d'Alma, P. Q., Can. This company is beginning the development of a 480,000-hp. hydro-electric development on the Saguenay River.

EDWARD S. WALSH, of Brooklyn, has assumed office in Albany, N. Y., as state superintendent of public works. He has appointed JAMES E. DOYLE of Syracuse as deputy superintendent of public works, and PATRICK J. CAWLEY of Syracuse as assistant superintendent in charge of the middle division of the Barge Canal system.

GANNETT, SEELYE & FLEMING, INC., engineers, requiring more space, have moved their Harrisburg office from 204 Locust St. to the Caplan Bldg., 1 N. Market Square.

WESTON & ELLINGTON, architects and engineers, are opening an office in the Stroh Bldg., Detroit, Mich., for consultation on building problems. WILLIAM C. WESTON, architect, has had 24

years of experience in San Francisco, Birmingham, Ala., Chicago and Detroit. HAROLD S. ELLINGTON, civil engineer, graduate of Armour Institute of Technology, Chicago, was formerly assistant engineer of the city engineering department of Chicago and has had 14 years' experience in construction of commercial and industrial buildings.

HARRY C. ASH has been appointed executive secretary of the Duluth, Minn., city planning commission. Mr. Ash was at one time assistant city engineer of Duluth; he has been construction engineer on many projects in Michigan, Illinois, and Minnesota.

F. J. KEIS has severed his connection with Norcross & Keis, Atlanta, Ga., to affiliate with Abbot, Merkt & Co., New York City.

CLYDE SEAVEY, city manager of Sacramento, Calif., has been appointed a member of the California State Railroad Commission for a full six-year term.

FREDERICK L. FORD, former city engineer of New Haven, Conn., together with his brothers, Robert N. and Percy N. Ford, has incorporated the Ford Bros., Inc., with offices in New Haven. The firm will carry on a general engineering and contracting business, with a capital stock of $100,000, specializing mostly in public works contracts.

PHILIP BOND, of the engineering firm of Franz & Bond, Holyoke, Mass., has recently accepted the position of city engineer of Holyoke. Mr. Bond will resign from the firm which will be carried on in the future by FRED H. FRANZ.

KENNETH MOLLER, of Lockwood, Green & Co., engineers, Boston, was elected a director of the Boylston National Bank, Boston, at the annual meeting held last week.

CLYDE W. WOOD, chief engineer, South San Joaquim Irrigation District, resigned on Jan. 1 to open an office at Manteca, Calif., as engineer and contractor, specializing in irrigation and drainage engineering and general construction work. Mr. Wood has been engaged in this line of work for twelve years, of which six and one-half years have been spent with the South San Joaquin Irrigation District.

C. J. BENNETT, who retires as state highway commissioner of Connecticut in July, was never employed by the Rochester Railway and Terminals Co. nor by the Terminal Railway of Buffalo as noted in these columns last week. Nor was he employed in N. Y. State Barge canal office. Most of his experience has been gained in Connecticut, where, prior to his being appointed to his present position he was superintendent of streets of the city of Hartford.

M. M. WILLCOX, former assistant engineer with the Pere Marquette Ry., has joined the engineering staff of the H. M. Byllesby Corp. He is stationed in Minneapolis.

FRANK E. PEACOCK, until recently an instructor in mathematics and mechanics at the University of Minnesota, has joined the Simons Co. of Chicago, Ill., as designing engineer in paper mill engineering-construction work.

A. W. WRIGHT, former structural engineer with the Eastern Steel Co., has become chief engineer of the Hamilton & Chambers Co., Inc., engineers, manufacturers, and contractors of New York City.

EDWARD M. LYNCH, of Los Angeles, Calif., has been re-appointed city engineer of Taft, Calif. He will serve for a year.

HENRY J. CHRISTENSEN and R. V. WOODS, construction and consulting engineers announce the opening of offices at 505 Seventeenth St., Oakland, Calif. The firm will specialize in reinforced-concrete steel and timber design and construction.

ANDREW M. JENSEN, formerly of the firm of JENSEN & ROSS, civil engineers of Fresno, Calif., has opened an office in the Griffith-McKenzie Building, that city, and will engage in practice for himself.

ARNOLD G. CHAPMAN of Albany has been appointed deputy state engineer by State Engineer LaDu, to succeed ROY G. FINCH. He is a graduate of Union college and entered the state service in the state engineer's department in 1905. He has held various civil service positions and was appointed deputy state engineer by John A. Bensel, holding this position until the change in administration in 1915, when State Engineer Williams appointed William B. Landreth to the position.

JAMES R. BARBER, division engineer of the Canadian Pacific Ry., Toronto terminals, during the past three years, has retired. Mr. Barber has been with the Canadian Pacific for many years, associated with the construction of the Credit Valley Ry., the Ontario & Quebec Ry., the Guelph Junction Ry., the Richelieu River bridge, double-tracking the St. Lawrence River bridge and the construction of the Sortin yard near Montreal.

H. E. MOSES, chief of the water-works and sewerage section of the Pennsylvania State Department of Health for the last six years, has been appointed assistant chief engineer to the department. From 1908 to 1916 Mr. Moses was with the department as assistant engineer on water-works and sewerage. He graduated from Dickinson College in 1898 and studied at the University of Maryland and Johns Hopkins University, subsequently. From 1900 to 1908 Mr. Moses was with the Harrisburg Foundry & Machine Works as draftsman and chief checker on the Corliss type of engines. At the outbreak of the World War he was assigned on sanitary inspection work in connection with temporary National Guard camps, and during 1917 and 1918 had charge of extra cantonment work in civilian areas adjacent to Camp Colt at Gettysburg.

THOMAS SMYTHE SCOTT, city engineer of Niagara Falls, Ont., has just been appointed city manager. During the early part of his professional career Mr. Scott was engaged on railroad work for the Grand Trunk Ry., later becoming associated with the Ontario Power Co. as field engineer in charge of construction work. Since 1904 Mr. Scott has been in charge of many important engineering works at Niagara Falls, Shawinigan Falls, Vancouver, and other places, as well as being assistant to the city engineer of Toronto. He was also assistant professor of civil engineering at Queen's University, Kingston.

CHARLES A. BURN has severed his connection with the Pennsylvania State Highway Department with which he was employed as resident engineer, and has become associated with the Dexter-Geare Corp., manufacturer of concrete products of Miami, Fla. Mr. Burn is plant superintendent.

RAY E. BEHRENS has been appointed county engineer of Waukesha County Wis., to succeed W. G. Caldwell who has opened up an office in Waukesha for the practice of civil engineering.

Obituary

WILLIAM ZUMWALT, a road contractor well known in the Island Empire, died Jan. 9 at Newport, Wash., aged 61 years. He had recently been doing state road work in the northern part of Washington.

EDWIN W. SANBORN, who for ten years had been connected with the civil engineering department of the Lackawanna R.R., died Jan. 4 at Newark, N. J., of pneumonia, aged 39 years. He was a graduate of Illinois College, class of 1906, and had lived eight years in Newark.

COLONEL LOUIS H. KNAPP, until recently a consulting engineer and for 28 years superintendent and engineer of the water-works of Buffalo, N. Y., died in that city Jan. 16 aged 74 years. He built the reservoir and intake tunnels in the Niagara river and other construction connected with Buffalo water-works.

HON. WILLIAM C. KENNEDY, Canadian Minister of Railways and Canals, died in Naples, Florida, Jan. 17, aged 55 years. He was born in Ottawa and during the earlier years of his business career was largely engaged in the development of the oil and gas industry in southwestern Ontario.

PETER STIPP, building contractor, who had lived in Scranton, Pa., more than 35 years and had erected many of the city's and valley's largest churches, schools and manufacturing plants, died in that city on Dec. 27, at the age of 64, from pneumonia. Mr. Stipp's facilities for construction work included his own brick yard and two stone quarries.

HUGH STEELE, vice-president of the James S. Lang Engineering Co. of Waltham, Mass., died recently in Hyde Park, Mass., at the age of 70. He was at one time construction engineer of the Boston-Providence R.R., and superintendent of grade crossings for a section of the old New England R.R. As superintendent of the South Terminal yards, Boston, he aided in the enlargement from 60 to 600 trains daily, and later he was superintendent of South Station, Boston.

JOHN CRISWELL, a civil engineer of the Pennsylvania State Highway Department, was killed Jan. 11 when the automobile in which he was riding on the Lincoln Highway between Downington and Woodbine, Pa., was thrown into the ditch in a collision with a limousine which went on without stopping. Mr. Criswell and DAVIS BOWMAN, driver of the car, were on their way to Pughtown where they were supervising the erection of a bridge on the West Chester-Pottstown highway.

From the Manufacturer's Point of View

A Point of Contact
Between Maker and User of
Construction Equipment and Materials

Road Show Brings Out Wide Range of Improved Construction Equipment and Materials

More Than 200 Exhibitors Fill Chicago Coliseum with Heavy Plant —Many Details of Design Changed for Better Operation

WITH construction equipment and materials valued at $1,500,000 occupying 79,000 sq.ft. of floor space in the Coliseum and adjoining buildings, the Good Roads Show held in Chicago Jan. 15-19, in conjunction with the convention of the American Road Builders' Association, presented to a record attendance of highway engineers, contractors, federal, state, county and city officials the products of 217 manufacturers. Embodied in the design of these machines were scores of new or improved features developed during the greatest road-building year in the nation's history.

The demand for exhibit space so far exceeded the area available that many manufacturers had to limit their displays and others could not be accommodated at all. This condition led to the passage of a resolution at the annual meeting on Jan. 17 of the Highway Industries Exhibitors Association creating a committee of seven to report on the feasibiltiy of financing and building, either independently or in co-operation with other national organizations, a permanent structure large enough to accommodate future road shows. It is significant of the growth of the highway industry that the facilities for display offered by the huge Coliseum have already been outgrown.

Trend of Design

This year's display of road building equipment offers opportunity for a few generalizations on the trend of design. Heavier machines of larger capacity than in former years are being produced. C. W. Kelly, director of exhibits, estimated the tonnage of products in this year's show at 120 per cent more than that of last year. In road-construction plant a greater degree of mobility is being secured by the use of crawler and motor truck mountings. To speed up moves of equipment within city limits rubber-tired wheels are being widely employed. Even on heavy slow-moving machines, such as cranes and elevating loaders, a range of two or more speeds is now provided instead of a single speed.

Gasoline engines as a source of power for road-building equipment have scored a big gain and tractor operation of graders, scarifiers, patrol maintenance equipment and dump wagons in trains is becoming general. For accurate measuring and batch-loading of concrete aggregate from bins into motor trucks or industrial cars, gravity-operated plants have passed the experimental stage and one of the newer developments is a device for measuring and loading cement into containers on motor trucks, thus eliminating all labor in handling sacks at the mixer.

Operation of equipment is being simplified and improved by such means as enclosed gearings, more convenient grouping of levers, heavier parts at points of greatest wear, cast-steel instead of cast-iron. New details in finishing machines permit the strike-off to operate, at different levels and subgraders now produce the new form of base for concrete pavements with thickened edges to meet the revised specifications of Illinois and other states.

In the trench-excavating field two new types of machines were introduced, one a "trench hoe," consisting of a power-shovel type boom and dipper which digs towards, instead of away from the machine, and the other an endless chain of digging buckets with a self-cleaning feature mounted on a vertical, instead of an inclined, boom.

Manufacturers making several different types of road-building equipment have made progress in standardizing parts to facilitate rapid assembly in the shops and repairs in the field. Graders are being provided with scarifier attachments and extension wings on blades. In this field, as well as that of the elevated loader, features have been introduced to adapt equipment to snow-removal work.

Road forms are being built of heavier metal, riser strips have been introduced to utilize old forms for thicker pavement slabs without discarding old forms and an entirely new type of road rail with curved top and two-part joint wedging device was shown for the first time, its feature being the complete absence of bolts, rivets or stake holes. Industrial haulage equipment, for batch boxes has been increased in capacity by the introduction of multiple-unit trucks holding as many as five batches. A great variety of traffic regulating devices in the form of illuminated signs on standards and mushroom lights for street intersections were on display.

This year the participation of the state highway departments and the U. S. Bureau of Public Roads was on a far larger scale than in any previous year. In addition to an elaborate display by the federal government, occupying 4,000 ft. of floor space, booths were occupied by the highway departments of Illinois, Georgia, New Jersey, North Carolina and Wisconsin.

In the space available for this report it is impossible to detail the features of each piece of equipment exhibited by each manufacturer. Many of the machines have been standardized by long periods of successful operation and their design is well known to the road-building field. The following notes, therefore, deal in the main with improvements in established types or with new types of equipment and materials.

Many Design Details Improved

Concrete Mixers—A larger charging skip, with double cables as insurance against accident, is one feature of the Koehring 32-E paver, on crawler traction, weighing 65,000 lb. On the 21-E machine the new feature is two derricks, one on either side of the charging skip, to facilitate handling of batch boxes. Double water tanks and rubber-tired wheel mountings are supplied.

The Ransom 21-E mixer has a new power discharge mechanism and the bull wheel for moving the skip has been replaced by bevel gears and vertical shaft forming an all-gear drive. On the discharge boom the former rod and turnbuckle support has been replaced by wire rope and pulleys for quicker and more accurate adjustment. Two traveling speeds of 60 and 175 feet per minute have been introduced.

The equipment of a small mixer, the

Highway Industries Exhibitors Hold Annual Meeting

At the annual meeting of the Highway Industries Exhibitors Association held in Chicago Jan. 17 plans were discussed and a committee appointed to investigate the possibility of building, either independently or in co-operation with other organizations, a permanent structure large enough to house future road shows. This action resulted from conditions created this year by lack of space in the Coliseum and adjoining buildings to take care of the exhibitors desiring to display their products.

In his annual report President S. F. Beatty, Austin-Western Road Machinery Co., suggested that the Good Roads Show might be held during summer, at which time the spacious Municipal Pier in Chicago would be adequate for handling all demands for exhibit space. The heating of the pier for winter exhibits also was discussed. Opposition to this proposal developed on the ground that no representative attendance of highway contractors and engineers could be secured during the summer months when work is in full swing. The executive committee of the association will take under consideration the projects for a permanent building and a show during summer.

The association now has 173 active and 27 associate members, making a total of 200. This year's officers were re-elected for another term. They are: S. F. Beatty, Austin-Western Road Machinery Co., president; John B. Hittell, Asphalt Association, vice-president; C. N. Leet, Milwaukee Locomotive Co., treasurer; and H. R. Snow, Autocar Co., secretary.

The newly elected board of directors consists of the four officers previously named and H. B. Baker, Holt Manufacturing Co.; C. R. Dodge, Northwest Engineering Co.; Frank Dunn, Dunn Wire-Cut Lug Brick Co.; C. R. Ege, Portland Cement Association; H. S. Greene, Barber-Greene Co., F. G. Hudson, *Engineering News-Record;* C. F. Messinger, Chain Belt Co.; and K. N. Talbot, Koehring Co.

An executive committee, consisting of the four officers of the association and C. R. Ege, Frank Dunn and K. N. Talbot, was chosen at a later meeting.

4-S, with a power loader, instead of a hand-operated device, was shown by the Chain Belt Co. On the larger crawler-mounted pavers a new safety feature is a skip guard while on the bottom of the discharge bucket a steel blade, adjustable in height, has been added to spread the dumped concrete. Another feature is the enclosure of transmission and reduction gears.

On the Smith 21-E crawler-mounted paver a new automatic measuring tank was shown. Another improvement is a worm boom swing. To facilitate railway transport on flat cars the height of the frame has been cut down 9½ in. to insure adequate clearance under all conditions of rail transport.

The Archer Iron Works has secured great mobility for its 1-bag mixer by mounting on a Ford truck chassis. A similar trend was noted in the Jaeger mixers which are being mounted on rubber tires; this company also manufactures a rubber-tired trailer mixer.

A new low-charging 7-cu.ft. mixer was shown by the Austin Machinery Corp.; its principal feature is a simplified discharge spout operated by a hand lever. On its 1-bag mixer the Marsh-Capron Co. has increased the size of the discharge opening.

The Foote Concrete Machinery Co. exhibited a low platform rubber-tired trailer for rapid transport of large paving mixers.

Grading Equipment — In the road-grader field developments took the form of a hinged double-ender attachment for extending the width of the blade on the Austin Machinery Co.'s grader and of scarifier attachments which are raised and lowered with the blade. This company also showed a road maintainer with adjustable blades on a steel frame hauled by a roller or tractor. The Russell Grader Mfg. Co. and others exhibited a variety of light patrol maintenance graders with blades 6 ft. in width. A new feature of that organization's elevating grader is a conveyor belt 42 in. wide. On the Adams leaning-wheel grader a back-sloper attachment was shown designed for building ditches and shoulders to specifications on concrete road contracts. Tractor operation is provided for in the Wehr one-man road maintainer. Both light and heavy graders were exhibited by the Good Roads Machinery Co., the smallest of these having a 5-ft. blade and the largest a 10-ft. lathe. Tractor operation of the Maney self-loading scrapers was featured by the Baker Mfg. Co. On the Avery tractor-operated power-lift road "razer" a recent improvement consists of a blade in three sections to fit any road curve or crown.

In the subgrader field a new Lakewood machine is supported on a steel frame and equipped with scarifier teeth and V-shaped blades. Additional sloping blades have been introduced on each side to form the new subgrade section required by the Illinois highway department's specifications for a paving slab with thickened edges. Another new Lakewood machine is the Graderooter; this machine, equipped with seven scarifier blades, is designed primarily for the preparation of subgrade and is operated with a tractor or roller.

Power Shovels and Cranes — Interchangeability for dragline, clamshell bucket or power-shovel work was a feature of the crane and shovel exhibits. A new attachment called the "trench hoe" was shown by the Northwest Engineering Co.; it consists of a shovel scoop mounted on a short dipper arm and operated toward, instead of away from, the machine. In its operating principle it embodies features of both the power shovel and the dragline. This equipment will dig a trench 14 ft. deep and from 27 to 48 in. wide, depending upon the width of the dipper used.

Improved three-lever control, power steer from the cab, two propelling speeds and independent operation of throttle and ram by a single lever were featured by the Bucyrus Co., in its 20-B three-quarter yard shovel; this machine has a two-part hoist and improved crawler mounting. The Brownhoist combination crane and shovel, with 40-ft. boom and 1-yd. bucket, is also equipped with two-speed drive; to secure a lighter bearing on soft ground the width of the crawler links has been increased from 15 to 19 in.

The Byers Machine Co. extended its line of cranes this year by the introduction of the Truckrane, an adaptation of a standard model with altered base designed for mounting on a standard motor truck chassis. It operates a ½-yd. bucket and its particular feature is the great mobility secured by the motor-truck mounting.

Other shovel and crane manufacturers, including Erie, Pawling & Harnischfeger, Osgood, Thew, and Fairbanks had exhibits featuring a variety of detailed improvements designed for increasing the strength and simplifying the operation of their machines.

Industrial Haulage—Four speeds, forward and reverse, are provided for in the new gear-drive Fate-Root-Heath 7-ton industrial locomotive. The same number of speeds is incorporated in a lighter model, 4-ton, manufactured by the George B. Whitcomb Co. One of its models designed for road contract haulage was exhibited by the Milwaukee Locomotive Mfg. Co. The feature of the Koppel exhibit was a muntiple-batch narrow-gage car mounted on two four-wheeled trucks carrying 5 batch boxes of 37-cu.ft. capacity each. This model represents an increase in size over former types.

(Continuel on p. 187)

THE ROAD SHOW—FROM THE BALCONY OF THE COLISEUM, CHICAGO

More Suggestions—

For Better Equipment and Repair Parts Service

IN THE Dec. 14 issue was begun a discussion of "Better Equipment Maintenance and Repair Parts Service." Its object is to show how some of the misunderstandings between maker and user of construction machinery can be avoided. This week's contribution is a recital of experiences by a manufacturer of locomotive cranes and buckets.

From a Manufacturer of Locomotive Cranes and Buckets

WHEN a locomotive crane leaves the manufacturer's plant it has been thoroughly tested and is in good operating condition. Usually it has to be dismantled for shipment to meet railroad clearances and requires reassembling to a certain extent after it reaches its destination. If the purchaser is familiar with this type of equipment, he should have no difficulty in reassembling the crane and putting it in operation.

Sometimes, however, a contractor who is purchasing his first machine, assumes that any man who has operated a donkey engine is qualified to set up and operate a locomotive crane. He does not appreciate that the service he can get from such a machine is more than 50 per cent dependent upon the operator. If a capable man is put in charge of a machine such as a locomotive crane, and he is interested in keeping his machine in first class shape and taking care of minor adjustments as they are needed, the life and service of the machine are unquestionably very much prolonged and better. A man who knows only enough to put fire in a boiler and perform the various motions necessary to operate a machine, can never get the best service out of it, whereas a man who is interested in his machine and takes pride in keeping it up, will also take pride in getting the most work out of it, and should be worth, in a season's run, more than double the wages paid to a man of the other type.

Manufacturers of locomotive cranes usually have a stock of spare parts on hand that, in an ordinary season's run, can be called upon for quick shipment. If the owner of a locomotive crane will allow his operator to make the necessary adjustments and order such parts as may show signs of failing in advance, he will ordinarily be required to shut down only a small portion of his time during a season's run. If, however, adjustments are not made at the proper time, one part after another will fail, and the contractor usually assumes that the machine is poorly built, whereas in nine cases out of ten, it is the fault of the operator, or a system which does not allow him to make the necessary adjustments and repairs.

Furthermore, the average contractor, when ordering repairs from the manufacturer, considers he is being abused if the part he requires is not shipped immediately. He does not realize that in a large organization a certain amount of time is necessary to see that he gets the part he wants. Usually his order is not specific. He orders the part by its popular name, as he has become accustomed to call it, and does not take the trouble to consult his files to see what the manufacturer calls this part. Changes are constantly being made in the construction of such machinery, and the newer cranes do not have the same details as the old ones, so that orders for repairs should specify the serial number of the crane for which the part is required. This serial number is always plainly stamped on the name plate, and, unless covered with grease and dirt, should be plainly visible.

Only the manufacturer appreciates the difference in customers. One man orders his repairs as he sees they may be needed, and if he obtains shipment within a reasonable length of time, is entirely satisfied. Another man will allow his machine to run until it is ready to fall to pieces, and then blames the manufacturer because he cannot get all the parts he requires within a few hours after he is obliged to shut down. Common sense and courtesy are big helps in ordering repair parts as well as in the operation of any equipment.

One big help in maintaining equipment such as a locomotive crane, is in keeping the machine clean. Some operators allow grease and dirt to accumulate until it is difficult to distinguish between the various parts. If a machine is operated by steam, a short piece of steam hose connected to the boiler will assist materially in washing off the grease and dirt that accumulate on these parts. If the machine is operated by gasoline, a reasonable amount of this fuel applied to the operating parts with a piece of waste will keep these parts in much better condition.

(To be continued)

Concrete Mixer Association Elects Officers

The Concrete Mixer Association of Chicago, an organization of manufacturers, at its annual meeting Jan. 18 elected the following officers: Lion Gardiner, Lakewood Engineering Co., Cleveland, president; G. Jaeger, Jaeger Machine Co., Columbus, vice-president; A. T. Scannell, Archer Iron Works, Chicago, secretary and treasurer.

Mead-Morrison Engineer Dead

Walter L. Cowles, structural engineer of the Mead-Morrison Mfg. Co., Chicago, died recently at his home in Oak Park, Ill. He was born at Wallingford, Conn., in 1859 and after graduating from the Sheffield Scientific School of Yale University in 1878 he gained a wide experience in bridge and structural engineering. Beginning in 1878 with the Clark Bridge Co., of Baltimore, Md (of which he became a member), he went to the Plant Railroad System in 1884-1885 as engineer of bridges. From 1885 to 1899 he was with the Morse, King, Atlanta and Keystone bridge companies, the Illinois Steel Co. and the Pottsville Iron & Steel Co. In 1899 he went to the Brown Hoisting Machinery Co. as structural engineer and some years later took a similar position with the Mead-Morrison Mfg. Co. At one time he was with the Holman Railway Tracklayer Co.

Prizes Offered to Improve Lumber Manufacturing Methods

The National Lumber Manufacturers' Association, Washington, D. C., has again offered a series of prizes which will be awarded to those who contrive the best method, the newest machine or device, which, in practical application, will result in an appreciable saving of labor, time, material or expense in the lumber manufacturing industry.

Heretofore a single prize of $1,000 was offered each year to the successful contestant. At the present time the National Lumber Manufacturers' Association is offering prizes amounting to $2,000, which will be divided as follows: First prize, $1,000; second prize, $500; three prizes of $100 each; four prizes of $50 each.

Owing to changing economic conditions it is becoming feasible to utilize certain by-products of wood that would not have been possible a few years ago. The elimination or reduction of waste incidental to the process of manufacture is becoming increasingly important.

A sawmill concerned only with obtaining merchantable lumber from a log, can utilize only about 25 or 30 per cent of the entire tree as it stands in the forest. This leaves a wide margin for the development of by-product utilization.

Three Marine Salvage Companies Merged Into Single Corporation

The formation of what will probably be the largest wrecking and salvage company in the world was consummated recently by the combination of the T. A. Scott Co., of New London, Conn., the Merritt & Chapman Derrick & Wrecking Co., of New York City, and the Overseas Salvers, Inc., of New York City, consolidated into a firm to be known as the Merritt, Chapman & Scott Corporation, with general headquarters in New York City. The new corporation will have a capital stock well into the millions and will operate along the entire Atlantic Coast, taking in the field formerly covered by the firms separately. The Scott company, formerly worked almost exclusively north of New London, and Merritt & Chapman south of New London.

The company will have headquarters in New York City and offices in New London, Conn., Boston, Mass., and Kingston, Jamaica.

The board of directors will consist of the following: I. J. Merritt, New York; J. R. Merritt, New York; Thomas A. Scott, New London; I. E. Chapman, New York; W. L. Chapman, New York; H. M. Pendleton; R. A. Fones, Clinton E. Roe, Richard H. M. Robinson, president of the United American Lines; S. F. Fales, R. L. Hague, G. P. DeWald, Herbert F. Boyston, G. H. Walker, Paul H. Harwood, J. W. Van Dyke, J. W. Powell, and Homer L. Ferguson.

The officers chosen are as follows: I. J. Merritt, chairman of the board; Thomas A. Scott, president; I. E. Chapman, vice-president; W. L. Chapman, secretary; R. A. Fones, treasurer. J. R. Merritt will be assistant to the chairman of the board; H. M. Pendleton will be second vice-president; and Clinton T. Roe, a lawyer, will be the company's attorney.

Road Show Brings Out Wide Range of Equipment

(Concluded from p. 185)

Elevating Loaders—Features of the Haiss elevating loader included improved crawler traction, enclosed mechanism and a special device for raising and lowering the boom; the clearance height at the discharge end has been increased from 8½ to 9 ft. The Link-Belt Loader is equipped with power swiveling mechanism and buckets arranged alternately with straight and curved cutting edges. For the Barber-Greene loaders snow-handling attachments are now furnished in the form of a 32-in. rubber belt instead of buckets, a longer and flatter boom and 6-ft. side plates on the receiving end to divert piled snow toward the belt. A type of open-top car unloader for sand and stone new in the East, was exhibited by the Edward Bacon Co., of San Francisco; it is a light, portable bucket-elevator device mounted on wheels running on railway cars.

Aggregate Plant—As a supplement to its Batcherplants for storing, measuring and delivering measured quantities of sand and stone from bins to trucks or cars, the Blaw-Knox Co. showed a model of a new cement-measuring and loading device. It consists of two parts, a sliding bottom dump trough on an elevated platform and a light steel box with hinged covers at top and bottom mounted on the bodies of motor trucks. Cement is delivered by gravity into the box compartments on the trucks and discharged into the mixer skip simultaneously with the sand and stone. The device eliminates labor in handling sacks of cement at the mixer.

Other types of batch-measuring hoppers were shown by the Butler Equipment Co., the B. S. Johnson Co., and the Erie Steel Construction Co.

New Road Form

Road Forms—An entirely new design of steel form for concrete roads was shown by the Lakewood Engineering Co. It is made of ⅛-in. metal and contains no bolts, rivets or stake holes. The joint is formed by two locking wedges and the top of the rail is curved to produce a line point surface on which no concrete or pieces of stone may lodge. This feature insures an even slab thickness when a finishing machine is used.

A 2-in. riser was displayed by the Metal Forms Corp. to increase the height of forms for thicker slabs. It fits under the bearing boxes of the rails, forming a single unit of increased height. On the Blaw-Knox forms new features are the one-piece stake strap and increased stiffening.

Finishing Machines—The new Heltzei finishing machine offers a combination of controls with independently operated strike-off, tamp and belt; other features include an adjustable-height strike-off, hinged wings of steel plate at each end to prevent concrete overflowing the forms, and the use of the weight of the machine to prevent concrete from raising the strike-off to a point higher than that set by the operator.

The new Lakewood finisher also has an adjustable strike-off; it may be operated at the level of the tops of the forms or at a point 4 in. below. For moving from one job to another transportation wheels are supplied.

The chief feature of the Maxon finisher is a divided strike-off; its two independently operated parts move back and forth in opposite directions to reduce the shove of concrete against the side forms. The Ord finisher made by the A. W. French Co., is designed with two heavy strike-off beams with wide under surfaces whose action kneads and compacts the concrete; the second beam gathers up and spreads excess mortar over which the first beam has passed.

Crushers—The new feature of the Smith gyratory crusher is the use of cast-steel instead of cast-iron. The company's exhibit at the show included a complete working model of a crushing and screening plant equipped with miniature primary and secondary breakers.

Gasoline Engines—The increased use of gasoline engines for operating construction equipment was reflected in the exhibits of 18 manufacturers. These ranged in size all the way from small units of 2 hp. weighing only 115 lb., as exemplified by the Evinrude exhibit, to the multiple cylinder types designed for operating power shovels and cranes. The Novo Engine Co. lays stress upon the development of its power units for construction purposes rather than the adaptation to construction work of automobile motors. The gas engines were shown in a wide variety of portable pump and compressor rigs.

A 60-hp. oil engine of the semi-Diesel type, according to claims of the Fairbanks-Morse Co., operates a 1½-cu.yd. dragline at one-quarter the expense of steam or gasoline rigs.

Compressors and Air Tools—For municipal and public utility work involving rapid moves from one point to another the Ingersoll-Rand Co. has mounted one of its portable type air compressors on a 1-ton Ford truck. In addition to its jackhamers and paving breakers there was a demonstration of the company's pneumatic clay digger.

A portable compressor, designed for operating two drills, a pneumatic paving cutter weighing 65 lb., a clay spader and a 6½-hp. Turbinair hoist weighing 285 lb., were featured by the Sullivan Machinery Co.

Vertical Boom Ditcher

Excavating Equipment—A new type of ditcher was shown by the Barber-Greene Co.; its feature is a vertical, instead of the usual inclined, boom carrying an endless chain of buckets equipped with a self-cleaning device which throws off earth by positive action. The ditcher can dig a 5-ft. trench 15 in. wide. The Chas. T. Topping Co. showed its new light weight pony ditcher.

On its back filler the Austin Machinery Corp. has improved control by a re-arrangement of operating levers.

Supplementing its cableway excavator, Sauerman Bros. showed a model of the power scraper, a wire rope and drag bucket device designed to be operated by power from a tractor.

Motor Trucks—Road-building requirements are reflected in motor truck features designed especially for this field. The necessity for traveling on the subgrade has led some manufacturers to equip with large pneumatic tires and to produce chassis with a comparatively short wheelbase.

A 72-cu.ft. batch-compartment body with swinging gates was shown on a Mack truck of the 2-2½ tons type. The cylinder bore on this machine has been increased from 4 to 4¼ in., resulting in greater power (29 hp.) and the body is made of only two sheets of No. 7 gage metal with rounded corners to facilitate the discharge of material. The increasing use of gravity loading devices, with the resulting shock of material dropped from a height, has led to the strengthening of the body by an electrically welded seam along the center.

On the Hug speed truck, equipped with 1½-yd. body, pneumatic tires are used and the weight distribution places the heavier load on the front axle.

On the General Motors truck a two-range transmission has been introduced to provide extra pulling power on bad roads and speed for smooth surfaces.

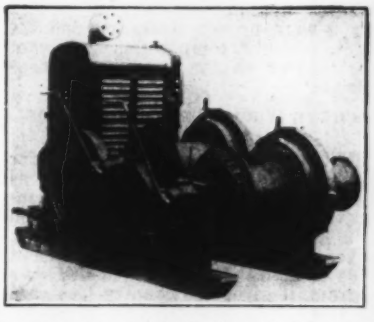
Miscellaneous—A new type of Elastite joint for concrete pavements, involving a tongue-and-groove feature instead of the straight-faced joint formerly used, was one of the novelties at the Philip Carey exhibit.

For rolling subgrade the Austin Machinery Corp. has designed a light-weight roller (3-ton), gasoline operated; it is called the Austin Pup and may be equipped with grader and scarifier.

Equipment and Materials

Gasoline Engine Hoist Designed as Equipment Unit

Designed as a gasoline hoisting *unit*, as opposed to a hoist coupled to a gasoline engine often unsuited for such purposes, the four-cylinder outfit (Type AF-DH) developed by the Novo Engine



Co., Lansing, Mich., is intended for use in connection with heavy construction operations. The power unit is completely housed. In addition to its compactness, other advantages are claimed.

One of the features is a full rectangular base and extra large main bearings which take care of side thrust resulting from transmission at right angles. With a speed of approximately 1,000 r.p.m. the engine delivers 20 hp. and is designed to operate under constant load that approximates its capacity, whereas the automotive or tractor modifications of engine types are under full load perhaps 25 per cent of their operating time. The speed of the engine is slower than that of the automotive type and two fly-wheels are furnished to insure uniform power output.

An automatic governor of the fly-wheel type is employed and in addition a hand-throttle within easy reach gives the operator, within the setting of the governor, the same control that exists with a steam outfit. All accessories of this unit are on one side for convenience.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Freight Car Pool Suggests Government Ownership

Adoption of Proposed Plan, According to Railway Association, Quickest Way to Induce Federal Control

Acceptance of the plan recently proposed to the Interstate Commerce Commission for the pooling of freight car equipment is the quickest way to bring about government ownership of the railroads if the shippers want it, Donald D. Conn, manager of the Public Relations Section of the Car Service Division, American Railway Association, told the Milwaukee Traffic Club on Monday night, Jan. 15, in Milwaukee, Wis. Speaking at the annual dinner of that organization, Mr. Conn, who was formerly chief of the Transportation Division of the Joint Congressional Conmission of Agricultural Inquiry, said in part as follows:

"To take one of the principal instruments—the freight car— by which the individual railroad maintains its livelihood under private and competitive operation away from that railroad and place it in the hands of an agency created by Federal Charter and financed through government funds, represents the initial step towards government ownership. If the shippers want government ownership of these railroads, the adoption of such a plan as is proposed is the quickest way to get it. If you want private operation and the maintenance of competition, you want to stay just as far away from it as possible."

Scheme Would Reduce Number of Cars Is Claimed

"The scheme now proposed for pooling freight cars is presented as a panacea for all of our transportation troubles but it means the creation of a meddlesome, additional agency, backed by $100,000,000 of government funds and, as designated in its own program, it gives the country less cars five years from now than there are today. A careful analysis of its practical application shows that the actual results thereunder are not only contrary to the claims being made, but also produce an actual increase in operating expenses. I want to stress the absolute fallacy of expecting any agency created under Federal Charter, which means by legislative act, and with government money, purporting to represent a desire and intent to perpetuate private ownership of the railroads."

Contrary to statements that have been made, Mr. Conn said the report of the Joint Congressional Committee which was compiled under his supervision, did not contain any recommendation which could "be used for the purpose of passing all of the freight cars of the country over to an agency which would be irresponsible for the financial or operating result of any single railroad system." The recommendation in that report urging "prompt consideration and adoption of a comprehensive

(*Continued on p. 190*)

Structural Steel Sales Begin Upward Swing

"Continuation of the building boom this spring is forecast by the upward swing in sales of fabricated structural steel in December," states the United States Department of Commerce. The report of the Department obtained through the Bureau of the Census, continues as follows:

"The increase of about 20 per cent over November marked the turning point from a series of seasonal declines in fabricated steel orders and occurred a month earlier than last winter, when December was the month of minimum orders. December sales amounted to 58.3 per cent of shop capacity, as against 48.4 per cent in November. Estimated total sales of fabricated structural steel in 1922 amounted to 1,929,400 tons or 64.3 per cent of shop capacity, as against 997,200 tons in 1921, or 35.1 per cent of shop capacity."

Table I shows final revised figures from April to November, 1922, based on reports of 158 identical firms having a capacity of 220,790 tons per month, together with the preliminary report for December, based on 141 firms. December figures are compared to the previous final figures by prorating to the estimated total capacity of structural fabricating shops, namely, 250,000 tons per month.

TABLE I—MONTHLY BOOKINGS OF STRUCTURAL STEEL TONNAGES

1922	Actual Tonnage Booked	Per Cent of Capacity	Estimated Total Bookings
April	198,529	89.9	224,800
May	180,558	81.8	204,500
June	162,139	73.4	183,500
July	152,023	68.9	172,300
August	150,700	68.3	170,800
September	141,418	64.1	160,300
October	126,535	57.3	143,300
November	106,315*	48.4	121,000
December	125,479†	58.3	145,800

* Two firms missing out of 158.
† From 141 firms who reported in time for this report.

Table II shows yearly figures of structural steel sales, based on new estimated capacities as the result of the special survey of the industry recently conducted by the Bureau of the Census, and the percentage of sales to shop capacity as reported by the Bridge Builders and Structural Society to April, 1922, and by the reports to the Bureau since then.

TABLE II—YEARLY SALES OF STRUCTURAL STEEL

	Estimated Monthly Tonnage Capacity	Per Cent of Sales to Capacity	Estimated Tonnage Sales
1913	190,000	50.3	1,146,800
1914	191,000	50.4	1,155,200
1915	194,000	70.0	1,629,600
1916	200,000	69.4	1,665,600
1917	207,000	60.2	1,495,400
1918	218,000	55.6	1,454,500
1919	224,000	53.4	1,435,400
1920	232,000	53.8	1,496,500
1921	237,000	35.1	997,200
1922	250,000	64.3	1,929,400

Use of Cement in Road Building Increased 41 Per Cent in Year

"The growth of the use of cement for highways is evidenced by the total yardage of concrete pavement awarded during 1922," states the Geological Survey in its statistical report on cement shipments, released Jan. 13. "These awards," the report continues, "for the total United States amounted to 79,000,000 sq.yd. or 7,900 mi. of 18 ft. roadway, as compared with 5,600 mi. of roadways awarded in 1921.

"Base mill price of cement in the Lehigh Valley district is $2. per bbl., ($10.00 per ton), compared with $2.10 ($10.50 per ton) in the Hudson District, and $1.80 ($9.00 per ton) around Pittsburgh, plus 10c. per bag for container which is repaid upon return. These prices represent a decline of 25c. per bbl. from ruling quotations up to the middle of October. During August, owing to railroad and coal strikes and increased cost of fuel, prices were advanced 45c. per bbl., and some smaller producers were forced to close mills on account of coal shortage. These mills reopened later and contributed to the heavy Fall production and shipments.

"Coal for which companies were paying $1.40 per ton in April rose to $8.25 f.o.b. mines plus $3.10 for freight in August. This involved an increase of over 60c. per bbl. in production costs, against an increase in price of 45c. Dropping of coal costs in October was reflected by a decline of 25c. per bbl. in mill price. Average net price received in the Lehigh Valley district, where a large number of mills supplying the eastern market are, was $1.78 ($8.90 per ton) in 1921; $1.91 ($9.55 per ton) in 1920, and $1.64 ($8.20 per ton) in 1919."

Business Failures Decrease

Decreases in all sections of the country except the Pacific states are shown in the number of failures reported to R. G. Dun & Co., and the total for the week ending Jan. 20, is 482, as against 546 for the preceding week. A year ago the figure was 639.

A substantial decrease is also evident in the aggregate of insolvencies with liabilities of more than $5,000 in each instance, which total 280 in the week of Jan. 20, compared with 335 in the previous period; the smaller figures also represent a smaller proportion of the total, being 58.0 per cent, as against 61.3 per cent for the week ending Jan. 13. Similar defaults in the corresponding week of 1922 numbered 385, being 60.2 per cent of the total.

Canadian failures, during the week, declined to 90 from the 108 reported for the preceding period; last year the figure was the same as for the week of Jan. 20, 1923. Defaults involving over $5,000 in each case number 47; Jan. 13, the figure was 46, and a year ago it was 44.

Bids Wanted—Apartment, Philadelphia, Pa., for Lincoln Drive Apartment Assn., $2,500,000.

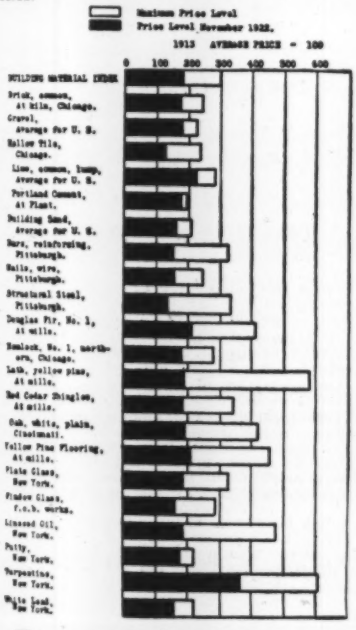
Rise in General Wholesale Prices Halted in December

Although the tendency of wholesale prices was upward in December, no change from the general level of the previous month is shown by the weighted index number compiled by the United States Department of Labor. This index, which includes 404 commodities or price series taken in representative markets, and which is weighted according to the relative importance of such commodities, rounds off to 156 for December, the same figure as announced for November.

INDEX NUMBERS OF WHOLESALE PRICES, BY GROUPS OF COMMODITIES.
(1913 = 100.)

	1921	1922	
	December	November	December
Farm products	120	143	145
Foods	136	143	144
Cloths and clothing	180	192	194
Fuel and lighting	199	218	216
Metals and metal products	113	133	131
Building materials	158	185	185
Chemicals and drugs	127	127	130
Housefurnishing goods	178	179	182
Miscellaneous	121	122	122
All commodities	140	156	156

To offset these price increases, there were decreases among important fuel and lighting materials and among metals and metal products. Fuel and lighting averaged almost 1 per cent and metals 1⅓ per cent lower than in November. No change in the general price level was reported for building materials or for miscellaneous commodities.



The accompanying chart, prepared by the United States Department of Commerce, shows the relative declines in various building materials since peak. Steel shapes reached peak prices in June, 1917; reinforcing bars, in July, 1917. Window glass, touched the maximum in August, 1918, and linseed oil in August, 1919. All the other materials reached peak levels in 1920, except sand and gravel, which commodities touched highest marks in January, 1921.

Building Permits and Contracts Last Year

Value of building permits in the United States last year was $2,514,435,467, which was 52 per cent higher than for 1921. The average of the two years is $1,860,000,000.

Value of contracts awarded for large commercial buildings and industrial works last year was $900,000,000, as reported by *Engineering News-Record's* Construction News. Residence building amounted to a billion and a half. Thus total building contracts in the country aggregated $2,400,000,000.

Number of important projects of all kinds reported by Construction News last year for the United States and Canada was 28,320, of which 11,425 were for buildings and industrial plants. Following is a comparison of the number of projects as reported at different stages, during the last four years:

	Contracts Awarded	Bids Desired	Proposed Work
1922	8,140	7,118	11,280
1921	7,047	6,831	11,699
1920	9,249	6,028	11,709
1919	6,993	4,789	13,861

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 43 to 54, are the following large projects:

Hotel, Detroit, Mich., to Lynch Construction Co., New York City, $5,000,000.

Manufacturing plant and addition, Camden, N. J., to Stone and Webster, New York City, $1,300,000.

Apartment, Detroit, Mich., to R. Appelman, $1,250,000.

School building, Baltimore, Md. to J. H. Miller, Inc., $1,124,420.

Materials Prices Today Compared With Other Times

Of the twenty basic building materials listed in the accompanying table, but three, (paving stone, flagging and curbing) are higher in price at the present time than in June, 1920. The other seventeen, including the principal building, concreting, road and paving materials, and pipe, are all from 13 to 64 per cent below the 1920 peak. The price of flagging advanced steadily from January, 1913, to the present level; that of bluestone curbing, from November, 1915 and paving stone, from September, 1916. These three passed through the peak period without undue rises in price as compared with other construction materials, which rose from 1913 levels to maximum points occurring approximately in June, 1920. Current sand and asphalt prices, f.o.b., New York, are the same as those in effect one year ago; but with recent advances in crude oil, higher asphalt quotations are anticipated. Lime and crushed stone are the only two items, of those listed in the tabulation, to show declines from last year's prices. Prevailing prices of the remaining thirteen commodities, are relatively higher than a year ago; particularly pine lumber, common brick, hollow tile and cast-iron pipe.

PRICES OF PRINCIPAL CONSTRUCTION MATERIALS CURRENT, AT PEAK AND PRE-WAR

Building Materials	Current	One Month Ago	One Year Ago	June, 1920	January, 1913
Structural shapes, 3-in., f.o.b., New York, per 100 lb.	$3.14	$3.14	$2.78	$4.47	$2.25@$2.30
Reinforcing bars, ½-in., f.o.b. New York, per 100 lb.	3.04	3.04	2.68	3.52@5.00	2.05
Structural rivets, ¾ in., f.o.b. Pittsburgh, per 100 lb.	3.00	3.00@3.15	2.25@2.40	4.50	2.10@2.20
Pine, 3x12 to 12x12, 20 ft., f.o.b. New York, per M. ft. b.m.	54.00	54.00	44.00	70.00	41.00
Common brick, alongside dock, New York, per M.	20.00	15.00@15.50	14.00@15.00	25.00	6.75@7.00
Lime, common lump, f.o.b. cars, New York, per bbl. (280-lb. net)	2.75@3.13½	2.75@3.13½	3.00@3.49	3.30	1.37
Hollow partition tile, 8x12x12, on trucks, Perth Amboy, N. J., per block	.2147	.2147	.1789	.3411	.105
Concreting Materials					
Cement, delivered, New York, without bags, per bbl.	$2.60@2.70	$2.60	$2.20@2.30	$3.30	$1.18
Sand, alongside dock, New York, per cu.yd.	1.00	1.00	1.00	1.50	.45
Gravel, ¾-in., alongside dock, New York, per cu.yd.	2.00	2.00	1.75	3.00	.85
Crushed stone, ¾-in., f.o.b., New York, per cu.yd.	1.75	1.75	1.80@1.90	2.15	.90@1.00
Pipe					
Wrought-steel pipe, black, 2½ to 6-in., lap weld, discount from Pittsburgh basing card	63%	63%	68%	42%	79%
Cast-iron pipe, 6-in. f.o.b., Birmingham, per ton	$44.00	$43.00@43.50	$35.00	$76.30	$22.50
Sewer pipe, standard, 6-in., f.o.b. Pittsburgh, per lin. ft.	.1575	.1575	.1305	.29	.072
Road and Paving Materials	....	.....	.....	.....	(Previous to 1920)
Road oil, 45% asphalt, at terminal, New York, per gal.	$0.06	$0.06	$0.05½	$0.13	$0.065 July, 1917
Asphalt, in bulk, f.o.b. New York, per ton	16.00	16.00	16.00	45.00	20.00 Nov., 1917
Paving stone, 4x8x4, dressed, f.o.b. Chicago, per sq.yd.	3.35	3.35	3.35	3.25	2.15 Sept., 1916
Flagging, 4 ft. wide, f.o.b. New York, per sq.ft.	.35@.40	.35@.40	.26	.25	.19@.20 Jan., 1913
Curbing, bluestone, 5x16-in., f.o.b. New York, per lin. ft.	.77@.85	.77@.85	.77	.70	.40 Nov., 1915
Wood block paving, 3½-in., 16 treatment, delivered, New York, per sq.yd.	2.63	2.39	2.17	3.75	2.00 Nov., 1917

(Concluded from p. 188)

plan for the central control and distribution of freight cars" was "never intended to support any plans calling for the pooling of freight cars or for a central financial agency," he said, adding that the recommendation made in the report is now being carried out by the Car Service Division of the American Railway Association.

"Under the program which was set down before the Interstate Commerce Commission last year by the advocates of such a plan, a definite program was proposed to retire 890,000 cars with a capacity ranging from 30 to 35 tons within the next five years, and replace them with 540,000 steel cars of 50-ton capacity. An analysis of the details of this proposal indicates that the total retirements at the end of five years would be 890,000 cars, the total replacement 540,000 cars, the total number of new cars built 250,000 cars, or an actual net decrease in the number of cars available for the use of the public at the end of five years of 100,000 cars. Not only does the plan contemplate a reduction in the actual number of cars available to the shipping public, but also that the capital expenditures that are made must be made for 50-ton cars. Are the trade units in this country, storage capacities, and the consuming capabilities of the country ready to utilize 50-ton cars and nothing else? While the railroads are generally adopting a standard of 40 and 50-ton box cars, I do not believe that any experienced railroad man or shipper is ready to say that all cars should be on a 50-ton basis. The average today is 42.2 tons, and this includes the high capacity coal cars. Those who advocate car pooling prey upon the car shortage conditions of the past fall and offer it as a remedy. It is contended that if such a plan is put in effect, cars can be moved around the country any time and in any way to suit the demands of the shipper. 'transportation shortage,' rather than car shortage is the term which correctly implies a lack of transportation to meet the demands of the shippers."

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of January 4; the next, on February 1.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$3.14	$3.95	$4.40	$3.02½	$3.15	$3.85	$3.25	$3.70	$3.50
Structural rivets, 100 lb.	3.85	4.60	5.25	3.75	4.00	4.80	4.75	4.25	6.00
Reinforcing bars, ¾ in. up, 100 lb.	3.04	3.85	3.15	2.92½	3.05	3.62½	—3.30	3.70	3.25
Steel pipe, black, 2½ to 6 in. lap, discount	54%	52.50%	45%	59½%	57-5%	41%	39.2@51.8%	40%	22.50
Cast-iron pipe, 6 in. and over, ton.	—54.50	—46.82	—56.00	+51.20@53.20	—55.16	—64.61	—54.00	—54.00	55.00
Concreting Material:									
Cement without bags, bbl.	2.60@2.70	2.54	2.25	2.05	2.29	2.85	2.71	2.90	2.88
Gravel, ¾ in., cu.yd.	2.00	1.75	2.25	2.25	1.75	1.90	2.15	1.00	1.50
Sand, cu.yd.	1.00	1.32	1.87½	2.25	1.00	1.00	1.50	1.00	1.25
Crushed stone, ¾ in., cu.yd.	1.75	2.00	1.80	2.25	2.25	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	59.00	36.00	50.00	52.00	42.75	51.50	+36.50	25.00	90.00
Lime, finishing, hydrated, ton.	16.80@ 17.10	23.00	22.50	18.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	2.75@ 3.13½	1.85	2.50	1.40	1.40	2.70	1.75	2.80	11.00
Common brick, delivered, 1,000	23.50	10.60	+11.00	11.00	18@19	12.00	15.50	—13.00	16.00
Hollow building tile, 4x12x12, per block	Not used	.0859	.115	....	.0836	.065	....	.11	.115
Hollow partition tile 4x12x12, per block	.1230	.0859	.115	.0674	....	.065	.108	.11	....
Linseed oil, raw, 5 bbl. lots, gal.	.93	+1.03	1.07	.98	+1.04	1.10	1.04	.86	1.02
Common Labor:									
Common labor, union, hour.	.60	.35	.30@.50	.....	.....	.50@.55	.56¼	.50@.60	.....
Common labor, non-union, hour.	.45@.60	.30	.30@.50	.72½	.35@.50	.35@.50	.50	....	.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Cement and concrete laborers' rate, 81½c.; pick and shovel men, 60c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.55 for Kelly Island and $1.45 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on Douglas fir instead of pine. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 99.00). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $22.50; 6-in., $108.

Changes Since Last Week

Cast-iron pipe down $1 per ton at Birmingham; drop reflected in similar declines in New York and Chicago warehouses. Iron and steel scrap prices higher; coke steady. Minimum of $2.10 per 100 lb. quoted on steel shapes and plates f.o.b. Pittsburgh. Minimum on bars, however, still placed at $2. Mill capacity rapidly filling up with heavy tonnage orders for railway and building materials, also plates for boiler, oil tank and ship construction. Steel mills operating at about 85 per cent of capacity. Unfilled orders on books of United States Steel Corporation, Dec. 31, 1922, totaled 6,745,703 tons, a drop of over 1 per cent since November.

Lumber market continues firm. Douglas fir up $1.50 per M. ft. in San Francisco during week. Demand unusually heavy for this season of the year; orders now about 26 per cent and shipments, 5 per cent above normal. Production, however, is 22 per cent below normal, as compared with 30 per cent below, Jan. 12, 1923.

Brick prices generally firm throughout the country. Seattle, however, reports drop of $1 per M.; slight advance in Dallas.

Linseed oil market strong. Both Atlanta and Minneapolis advanced prices 3c. per gal. during week.